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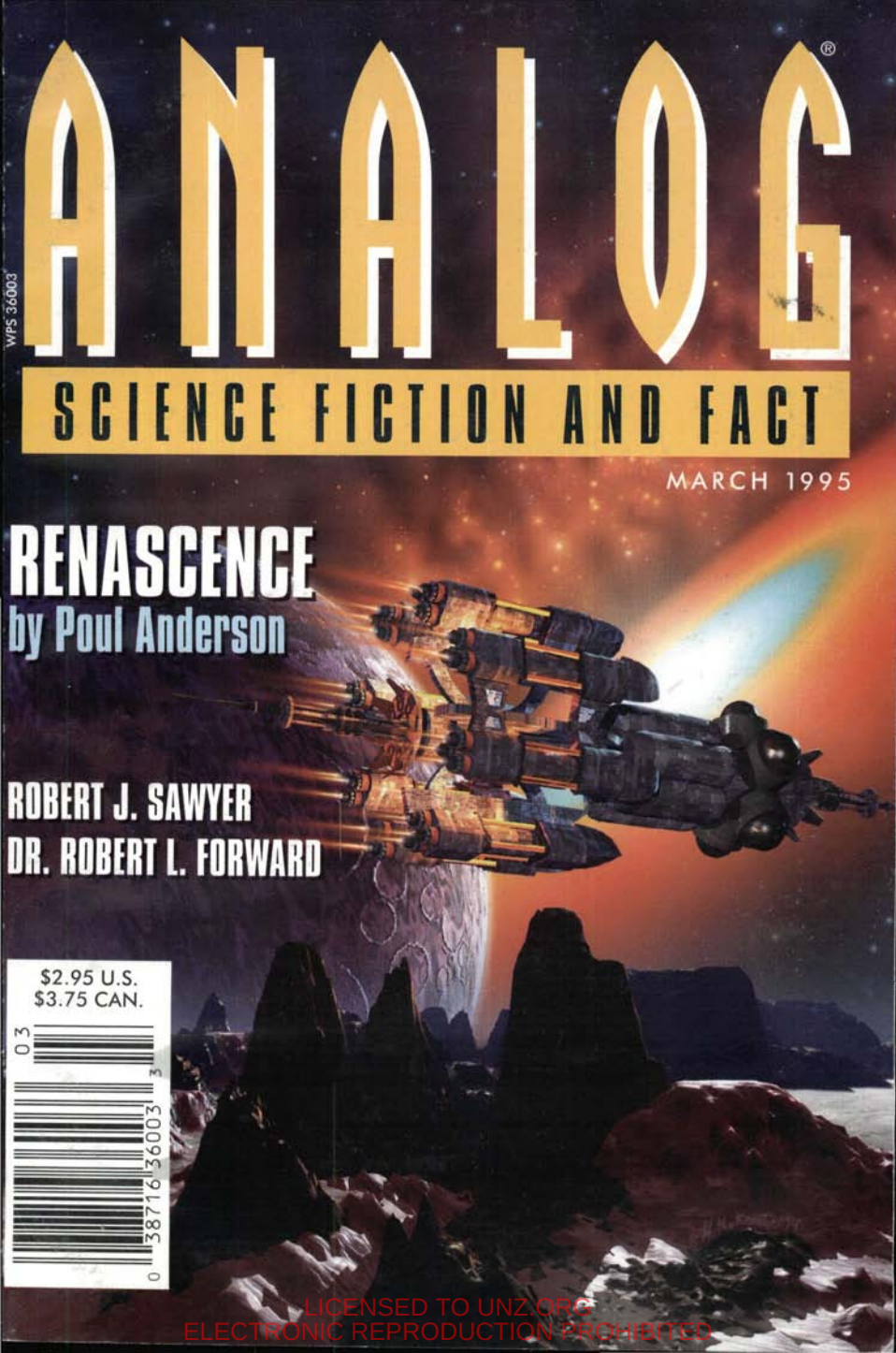

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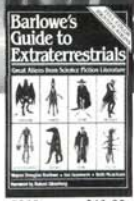

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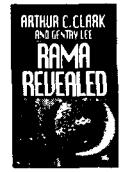

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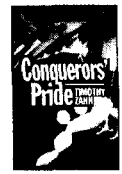

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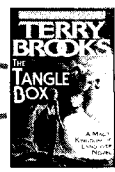

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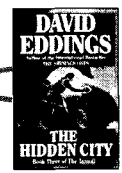

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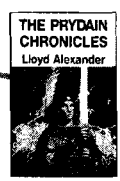

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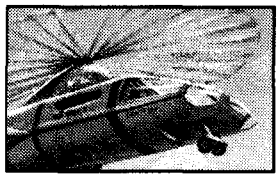

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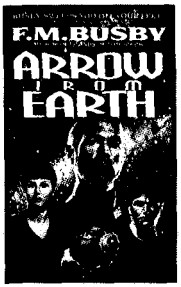

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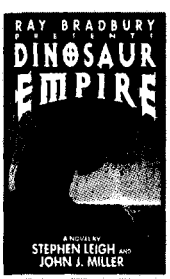

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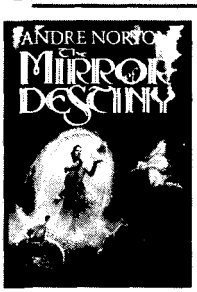

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EDITORIAL Stanley Schmidt

THE POLITICAL JUPITER EFFECT

A month after the fragments of Comet Shoemaker-Levy 9 plunged violently into the atmosphere of Jupiter, we stand at an intriguingly uncertain moment in history. Overshadowed by the fireworks show itself, a phenomenon perhaps even more remarkable has been triggered by the rocky "bombs." The question is, will anything actually come of it? Or will it fizzle out as memories of the Jupiter impacts fade, eclipsed by the latest silly fascinations with the shenanigans of rock stars and politicians?

By the time you read this, we may all have a pretty good idea of the answer. I have my own guess about what it will be, but thought it might be interesting to cast in front of the public *then* a reminder of how things look *now* (in August 1994).

The main event was spectacular enough. As predicted in Peter L. Manly's article in the July 1994 issue of *Analog,* some 21 mountain-sized objects hit the gas giant in a series of huge fireballs, each packing a wallop far larger than the total nuclear arsenal of all the nations on Earth. Whether those impacts had effects anything like those in "Symphony for Skyfall," the novella Pete Manly and coauthor Rick Cook had in that same issue of *Analog,* we can only guess. Maybe there really are intelligent natives on Jupiter whose lives were thoroughly disrupted, but at present we have no way of knowing.

We do know, however, about the side effects the comet impacts on Jupiter had on *this* planet, and in particular in this country. In at least small ways, they got many people thinking for the first time about the fact that such collisions are *real*—that they can and do actually happen, that they can do a great deal of damage, and perhaps even that they could happen *here.*

It isn't really surprising that *Time* had an article a week or so after the show, with a sidebar titled "What If a Comet Hits Earth?" Perhaps it's not

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even surprising that a politician or two would speechify about the need to protect ourselves against such hazards. After all, it does make a good attention-getting device, conveniently bolstered by all the coverage of the destruction happening somewhere else.

What *is* surprising (the "remarkable phenomenon" I mention above) is that a whole committee of congressfolk—the House Subcommittee on Science, Technology, and Space—actually drafted legislation aimed at putting the talk into practice. Specifically, the amendment to a NASA appropriation bill would require NASA to find and catalog all potentially dangerous Earth-orbit-crossing comets and asteroids.

That's only a first step, of course. Knowing what's on its way to hit you is useless unless you're prepared to do something to stop it. But knowing *is* a first step, and I find it remarkable and commendable that any recognizable twig of government, with its legendary reluctance to care about anything beyond the next election, has done even that. After all, while there's abundant evidence that Earth has been struck by big objects several times in the past, it's also true that major impacts were separated by thousands or even millions of years. It's not terribly likely that the next will occur during the lifetime of anyone now on the planet, much less during the term of office of anybody now in Washington. So I applaud this evidence of unexpectedly long-term thinking—if that's what it really is.

My somewhat cynical question, of course, is this. Will anybody in government still be promoting this in five years, or even five months (when you'll be reading this)? Or is the current flurry of talk about "It could happen here!" merely obligatory talk intended to reassure voters while their attention is temporarily on Jupiter? Some politicians may feel that some such gesture is called for, but can be quietly forgotten once the show is over and the public has lost interest. After all, it's a political axiom that the public has a very short memory. . . .

However, the Universe doesn't. So I'd *like* to believe that our government—or *some* government, or coalition of governments—really will follow through on cataloging potential threats and stockpiling antidotes. The danger of asteroid or comet impact is very real and very large, by at least one important measure; and it

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will *not* go away, even if the interest of politicians and electorates does. There *are* thousands of objects out there in orbits that could eventually bring them close enough for collision. (For details, see Manly's paper "Near Earth Asteroid Densities and Their Detection Before Impact," in *The Journal of Practical Applications in Space* [Vol. 2, No. 1, Fall 1990].) There have been near-misses within the past decade, at least one of them noticed only afterward. A little closer, and . . .

Put it this way. We hear a lot of loose talk these days about this or that threatening "the end of the world," or at least of "life as we know it." In most cases such talk is gross rhetorical exaggeration; the planet, and even the biosphere, are much bigger and more resilient than people commonly realize. A really large asteroid impact is perhaps the only easily imaginable thing we know of that really *could* wipe out all or most life on Earth (as similar events seem to have done several times before). The barrage that hit Jupiter would have; any *one* of those impacts might have.

And it could, at least on the basis of our present very sketchy knowledge of those orbits, happen any time.

True, it's not *likely* to happen soon. But it *will* happen sooner or later, and it *could* be sooner. In deciding how much effort to put into protecting yourself against a potential danger, you have to consider not only how likely it is to occur in any given time period, but how much damage it can cause if it does. Any randomly chosen

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house is unlikely to burn down; but if it does, its owners will probably be wiped out financially. So sensible owners try to avoid fire hazards and buy insurance.

In the case of comets and asteroids, as far as we know now, the likelihood of a big impact's occurring in this decade or next is very low—but if it does, it really could destroy human civilization, if not the human species. Therefore it warrants at least as serious consideration as some comparably improbable but far less destructive danger such as a nuclear power plant meltdown.

Furthermore, please note my repeated use of such qualifiers as "on the basis of our present very sketchy knowledge." It would be particularly foolish to leave our decisions about what, if any, precautions to take on such a flimsy basis. Odds are what you use when you don't know enough of the details to make individual predictions. In this case, that's not necessary. We *can* know a lot more about the individual details than we now do. Somebody just has to take the time and trouble to look carefully.

Of course, they'll have to *keep* looking. We still can't solve the general many-body problem in mechanics, and all the bodies in the Solar System continually perturb the orbits of all the others. So a catalog of all nearby bodies and their present orbital parameters is good for short-range predictions, but becomes less reliable the farther we try to extrapolate it into the future.

But even short-range predictions would be a lot better than the cosmic roulette we're playing now. Perhaps, after a few years of observing and measuring, we could say confidently that there's nothing to worry about for the next few years, and no need to frantically build defenses. Or maybe we'll find that there *is* something to worry about, but there's still time to do something about it.

The third possibility, of course, is that there is something to worry about and there's *not* time to do anything about it. Might that possibility cause some to oppose doing the survey because they'd rather not know if that's the case? It may; plenty of people put off going to the doctor while they could still be cured because they're afraid of being told they're really sick. On the other hand, I'm told that terminally ill patients often prefer knowledge to nagging uncertainty.

And some of them take it as a challenge and find ways to beat the grim prognosis.

For myself, I think I'd rather know—preferably early enough to have a good chance at a cure if one is needed. So I'm hoping that the "political Jupiter effect" really has given our legislators enough of a kick in the pants to do something serious about learning what's out there and what, if anything, we need to do about it. The initial check-up, at least, is not all that expensive in government terms.

But I can't avoid this nagging suspicion that the talk *is* just political response to a media event, and will fade as quickly as it came.

We shall see. ■

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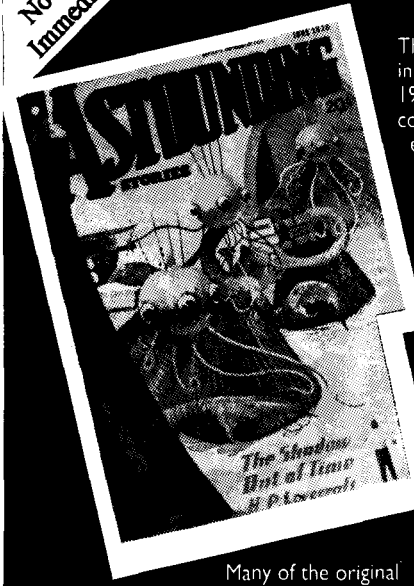

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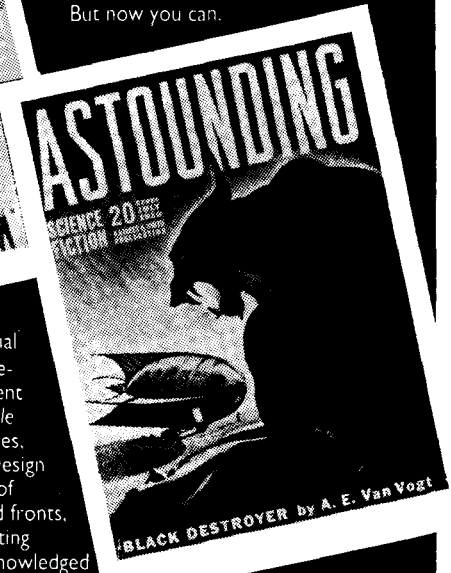

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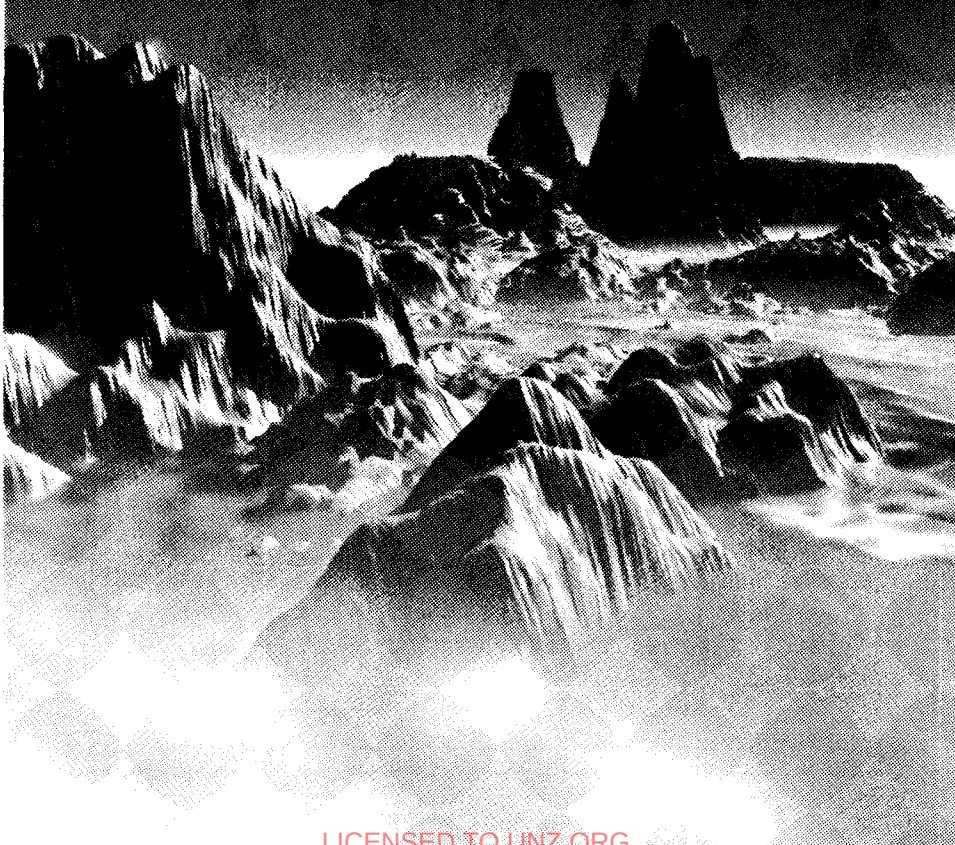
The scope of life may be far wider than most humans think—but there's at least one human trait that's likely to persist through even the most extreme changes. . . .

Illustration by George M. Krauter



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I think he told me this because I am his daughter. Not that he begot me in his flesh. When I was born, he was still homebound on a voyage that had begun almost three hundred years before. When we spoke, he was machine. But my father and my mother bore the genomes of him and his mate. They were created with the same basic memories, harking back to Earth itself, and even with some shared recollections of lives lived afterward. Also, it happens I resemble her as she was when young. Machine or no, of course he loved me once we had met.

What he said was that if I cared to hear the full tale of why he had returned so much earlier than planned, he would be glad to tell me. Oh, but I cared!

I think, too, he needed this. He had downloaded his knowledge into the appropriate databases, but that is impersonal. He had communed with the Life Mother of our planet, but that is sacred. I wonder if she counseled him to seek ordinary human connection. She may well have. In his awareness, the terror and solitude were only days behind him. Unbroken, he was nonetheless shaken, wounded. Maybe those hours with me helped speed his healing. Maybe he went back the stronger for it, to face the thing again. I would like to believe so.

We walked out of Rydberg and upstream along the Argen. On our right the poplars whispered with breeze; their pale leaves snared sunlight and spattered it across their shadows. On our left the river gleamed and murmured. Beyond it a farmscape, green, green, and golden, rolled away toward hills left wild. Here and there, brightness flashed off an attendant robot. Both moons were aloft, wan crescents in a blue crossed by cloud scraps and wings. The air drifted warm, full of herbal smells.

We soon got past sight of the town. When we came to a mossy bank, I knelt to drink—the water here has a slight iron tang—and sat down on the softness. A butterfly went past like a bit of rainbow. I could well-nigh feel the presence of the Life Mother, watching over and warding everything with which our ancestors seeded this world. The black hole seemed more than remote, it seemed to lie in another reality.

But my companion had gone there. The body that he wore today stood upright, two-legged, two-armed, two-handed, until it settled at my side. In its turret he produced the moving image of his mortal head, which could have been my father's, blocky, reddish-haired, rugged-featured. Somehow these homelinesses made that of which he spoke all the more freezingly alien.

And he himself had not been human then, not really, in the way I am. Nor was he now, in spite of the many everyday touches that endeared him to me. I cannot tell his story or that of his Demeter as it was to them. My brain is not electrophotonic. I do not have machine sensors or capabilities. Nor was I ever grown as an adult in a tank; I was born from a womb. No memories of past existences were ever downloaded into me; mine are just what came directly to this one

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organism during the thirty years I have been alive. Pseudo-experiences in a dream box give little feeling for organometallic regenesis. Those are too unanimal. I will not understand them until I have been through my own. Do you?

I must tell what I heard as I heard it, in ordinary language, therefore fragmentary and often false—what they found yonder. They awaited strangeness. Theirs was the first expedition to the first black hole identified within practicable range of any dwelling place that any of our races have found thus far. Yet their ship, at not greatly less than the speed of light, was a century and a half in passage. "Maybe we should've expected not only surprises, but thunderbolts," his voice rumbled to me like my father's. "How could we have known, though? For sure, nobody could've warned us."

At the moment it computed as best, the ship closed circuits to awaken them. Reactivation brought an instant's bewilderment. In their minds, they had begun accelerating outward and had finished lasering their farewells back to our world. Now immediately they confronted foreign space, and our Sun was among the stars, by no means the brightest.

Orientation crystallized. Microgravity and the silence of airlessness were familiar enough. Most of the sky around them had changed little: the stellar horde, red, yellow, blue-white; the galactic band toppling through it, an iciness broken by black gulfs of cosmic dust; nebulae lacily aglow; sister galaxies afar and afar; radio seethings, hard particle sleets. Despite it, this was foreign space. Before them burned the fire that ringed their destination.

Anson Guthrie gusted a sigh. "Well, old girl," he said, "we made it."

Of course those were not sounds. They were signals that he willed into his transmitter. But her brain interpreted them as he intended, for she too had many fleshly as well as machine lives behind her. They possessed communicators more subtle or more powerful, to use at need. What they wanted at this minute was to be together.

They could not clasp hands. Their braincases lay deep within a heavily shielded control complex. However, they had means to generate their images for one another. She "saw" him in his young manhood, on a beach where surf brawled beneath a sharp wind. For him, she appeared as she had first been synthesized, long ago on a planet long since destroyed —dark-haired, amber-skinned, hazel-eyed, she whom in her manifold recreations on our various worlds and in their various histories we have always named Demeter. A forest surrounded her.

They stared, laughed, ignored the contradictory settings, and feigned an embrace. Their lips met. "Darling," she said, immortally his beloved. Then she stepped back. Her smile trembled. "That was sweet, in its ghostly fashion. Just the same—"

"Wait'll we go mortal again," he answered. "I'll give you some sweetness that isn't ghostly. You'll be walking

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bowlegged." It came out more harsh than humorous. He had never quite liked being a download, an encoding of memories and synapses. For him it was thin stuff compared to being organically alive. Whenever his program was put into a newly made human Guthrie, he most often had it simultaneously removed from the neural network, declaring that for the time being he was tired of the machine condition and it didn't care to continue by itself.

Demeter completed her sentence: "—We'd better pay attention to where we are."

"Right," he agreed, a lilt entering his tone. After all, adventures and achievements are possible to machines where humans can never go, let alone survive. When organic, he regretted that he could not perfectly remember everything he had encountered.

A versatile problem-solver, the ship would have determined this was a safe region. But it was robotic, without conscious personality. The minds aboard it were what would perceive and seek to understand.

Demeter consulted its database and instruments. One of the downloads that went to make the very first Life Mother, at Alpha Centauri—and thus, eventually, passed into the first Demeter Daughter—had been a space pilot's. While she examined the parameters of vessel and orbit, Guthrie linked himself to an astrophysics program. Thereby made expert, he studied the black hole around which they swung.

Their distance was a cautious twenty astronomical units. Magnification and enhancement were required to get sight of the body. With a mass of some ten sol, its event horizon was a few tens of kilometers across. In the screen it showed as a blue-rimmed dot of utter darkness. Had the ship's path not been at a high inclination, not even that much would have been visible, for around it whirled an accretion disc. Matter spiraling inward gave off a torrent of quanta. Millions of kilometers out, the fire was dim, radio hues, but closer in it blazed ever more savagely, microwave, optical, ultraviolet, X-ray, a maelstrom through which lightnings leaped and shadowlike transients flickered. At first he could not really see it; his mind must learn how. He never became able to make visual sense of the inner edge, where atoms were plunging to oblivion through a time that his clocks measured as infinite.

Demeter joined her regard to his and whispered, "I knew we would be awed, but this—"

"Yes, we certainly had to come look close up," he said as low. "Already I find things I can't explain, things we probably couldn't have noticed from home base."

She took her own refuge in straightforward science. "Like the reason the disc is so bright?"

He formed a chuckle. "Give us a chance to snoop around first, will you?" Thoughtfully: "Yes, they do wonder about that. No companion star to steal material from. The interstellar medium's got to be denser hereabouts than average. My guess at

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the moment is that Packer's idea is right. You remember? When the supernova went off, its gas caught up with the planetary nebula puffed out at the red giant stage, and a part has been rebounding from the shock wave ever since. It's happened preferentially in the equatorial plane because of rotation, and gravity would reinforce this, and then as the stuff gets near there'll be the effects of distorted space-time—maybe. We don't know yet. Nor do we know whether this is a typical or a fluke, like maybe a quite small and close companion that got blown to bits in the explosion. We're here to find out."

Her voice caressed him. "Dear old bear. Metal or meat, you do like to growl on and on, don't you?"

"Aw, you're just saying that to make me feel good. Let's get busy."

Their condition had its advantages. They could commence work directly, and go for hours before they needed a download's equivalent of sleep. If anything, the temptation in the years ahead of them would be to neglect the human side of their psyches. That could have ill consequences. They must make a point of idle talk, relived memories, participatory illusions. At the moment, though, fascination caught them up.

Initial observations went fast; the ship's hypercomputers interpreted them faster. Guthrie and Demeter set it cruising, zigzagging inward, at accelerations that would have crushed their mortal bodies.

This was through daycycles that I cannot tell about, for we organics cannot be single-minded methodical; and as for their respites from it now and then, those belonged to them alone. I can merely say that they took pictures, spectra, meter readings from hundreds of positions and angles; they obtained long-base parallaxes; they sampled atoms, molecules, dustmotes, meteoroids, and measured the streamings of these. It was all preliminary. Probes to the black hole, and into it, were for later. But the explorers were not so distant from their origins on ancient Earth that there was not a special eagerness in this initial quest.

They found what they hoped for.

The data fell into a Euclid-clear pattern. "Planets," Demeter said like a song. "At least two planets."

"Well, if some pulsars have them, why not a black hole?" Guthrie replied. "The question is how."

Can jovian or superjovian worlds in remote orbits survive a supernova blast that vaporizes lesser, closer ghosts? Most of their own mass will go likewise, the gas and ice; but might the dense cores remain, incandescent, perhaps molten, then slowly cooling? Or it is possible that an eerie rebirth takes place, whole new bodies coalescing in the less energetic fraction of the matter that burst from the giant star? However small, that fraction must still amount to several times what encircles our Sun.

"This isn't a pulsar," Demeter said. Her exultation shivered a little. "How violently did it die, when its remnant was too big to collapse down into quarks, but is falling in on itself forever?" Resolution returned with laughter. "Nevertheless those planets

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move. Let's us!"

By now they were not far from the inner one, and laid an intercept course. Rounding its primary at a mean distance of about three astronomical units, it had a mass of about two and a half terra. The mean specific gravity, 5.8, betokened a metallic body with a rocky crust; spectral and radioactivity analysis would give details. The rotation period was 8.7 hours, with slight axial tilt. Those were the preliminary numbers. What met the travelers, as they took parking orbit and gazed out, was a terrible majesty.

Seen from there, in the ecliptic plane, the accretion disc became a double convex lens, two degrees across. Its edges hazed away in a radio blur against the stars. Inwardly the radiance heightened, until at the middle a furnace of annihilation and creation blazed gamma-white. Electrons, protons, and their antiparticles fountained forth, hurled on electric fields to which, even at this remove, the circuits of the ship thrummed. You, looking straight at the single octave your eyes can use, would have beheld a fierce iridescence; then you would have died. Guthrie and Demeter saw the whole fury, stopped down a thousandfold lest it burn out their sensors. They quickly turned to the planet.

At first it appeared stark as any moon. Polar caps and scattered ice fields mottled darkling mountains, uplands, plains, valleys. Impact craters were surprisingly few. Those of volcanoes exceeded them by hundreds. A smoke plume, big enough to be visible from space, declared that eruptions still went on; surely other diastrophisms did as well. Most features looked oddly smooth, as if eroded, although the highest of them must be geologically new. Subtle colors washed the underlying grays and browns, hints of rose, violet, marigold. Micalike points of brightness sparkled. Could the atmosphere be responsible? It misted the line between day and night; as the ship swept from hemisphere to hemisphere, it made vague sunrises and sunsets; but otherwise it seemed almost of vacuum clarity.

Guthrie and Demeter were a long while silent. In human phase, they would no doubt at once have sought telescopic views. As downloads, they had machine patience. They considered what was around them, absorbing it piece by piece, thinking. At the backs of their minds they sensed the instruments and computers to which they were linked, at work, as you might be half aware of some routine thing your hands are doing.

"Beautiful, in its way," she mused at last. "And terrifying."

"How come?" he asked.

"Oh, philosophically. So many suns and worlds in the Universe, but life so rare. This—" Her shadow self gestured. "It's as if nature were always blindly trying to make a place for life, and nearly always failing."

"Well she lucked out with us, and we're carrying on the job for her. Give us a few million years."

The argument was old between them. After all their centuries, everything between them was, save for whatever newnesses they found out-

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side themselves. Still, they had not wearied of saying their feelings to one another, as they had not wearied of making love.

"How much time has this planet had?" she wondered.

"We should soon be able to make a pretty fair guess. The observations are taking shape. Listen."

Presently: "Thin air, mostly nitrogen. That suggests the planets did form after the blowup, wouldn't you say? A boiloff oughtn't to have left any air at all."

"And no jovian planet could have condensed this close to a working sun, especially a blue giant," she pointed out.

"Um-m, friction with the supernova gases could've shortened the original orbit. But if this body dates from after the explosion, I'd have expected more of an atmosphere, considering its size. Maybe, in that environment, there weren't a lot of comets, to bring in volatiles. Notice the scarcity of craters. We'll want to check whether the system's got anything like a Kuiper belt or an Oort cloud."

He felt how she thrilled. Year upon year of discovery! However, her words stayed meditative. "Perhaps the atmosphere was originally thicker, but radiation from the accretion disc kicked most of it free. High-energy photons making ions, which the ambient electric and magnetic fields accelerated away—yes, destroying chemical compounds too, letting hydrogen break from ammonia and escape while nitrogen stayed behind—Any complex organic molecules that had formed were degraded. Maybe nothing remains on the surface but frozen carbon dioxide mingled with water ice, and . . . elemental carbon?"

"Hm, I should think that scenario depends quite a bit on the planet's personal magnetic field. How strong is it? . . . Hold on!" Guthrie exclaimed. "Something damn funny here."

She glanced at the data and gasped.

The field was not simple or steady. Nor did its pulsations follow the shudders that passed through the black hole disc and out across space. It choired. Around a stable half gauss, which must arise from the core, vibrated electronic voices, faint but multi-millionfold. Intricate harmonics went from horizon to horizon, around the curve of the globe. Digitals blinked, one-null-null-one-one-one . . . beyond counting. Thermocells registered scores of points whose cold suggested cryogenics underground. Fluctuant radio bands soughed in the heavens—

"Don't just float there," Guthrie croaked to the ship. "Give us a real look."

It heard, without knowing that it heard, although the command he sent down the circuits was what it responded to. Magnified imagery brought the surface within optical meters. Guthrie and Demeter saw.

Crystalline. No better word came to them. Valleys, plains, hills, mountainsides bore an endless intricacy of shapes. A coral reef might give a hint of description, here reaching aloft, there hugging the ground, convoluted, porous, sometimes blockily

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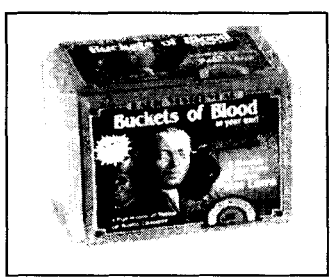

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massive, sometimes clockwork delicate, always more fantastic than dreams. But these forms were generally sharp-edged, angular, akin to spar, quartz, pyrites, shards of glass, facets on jewels. Among their murky hues, occasional mirror brightnesses flung light back to space. And surely the totality of them reached deeply downward.

During an orbit and an orbit, the watchers learned that weirdness did not cover the entire globe. Extensive regions of it, amounting to about a fourth, were ordinary rock, regolith, dust scudding before chill winds. "Around the meteor craters especially," Guthrie muttered. "That might explain why they're few. The rest have been . . . eaten, converted. Sites rich in minerals? Those that are left may be poor, unless the thing simply hasn't gotten to them yet."

"What *is* it?" For a time Demeter lay mute, until she blurted, "A monstrous artifact? Who could have built it?"

Guthrie shrugged phantom shoulders and put bravado in his ghost-voice. "I dunno. But I kind of doubt that. To me, this hasn't got the look of anything serving a purpose. Individual structures, yeah, but no overall coordination. At least, that's my first impression."

"Those signals—"

"Are they signals? Communication? Let's do whatever analysis we can."

Eagerness flamed. "If it is intelligent, we'll call to it!"

"Yeah? If it is a cybercosm, do we necessarily want it to know about us?"

She made no answer. He felt her remembering what has engulfed Earth. Not that that is evil in itself; but our worlds are biocosms.

"No, I don't suppose it can be," she said at last. A hope, a fear?

The ship kept orbit. Its receivers drank in the emissions from the planet. Its computers ran through the data, over and over, seeking patterns that could mean awareness. Information is equivalent to negative entropy. But billions of gigabits must be sifted to determine how often the statistically improbable occurred and what its nature was.

Guthrie and Demeter made what observations they were able to. They studied, thought, discussed. Setting the clues they got alongside that which astronomers at home had learned and conjectured, they began to sketch out a history of this system.

Closely determined at close range, the black hole's mass indicated how large the original star must have been, and thus the manner of its perishing. The ship had automatically collected data on its surroundings as it traveled. Although the nebula given off in the early stages of death had dissipated, traces remained in the interstellar medium, and the shock wave of the supernova was still clearly identifiable. Calculation forward from theory and extrapolation backward from fact converged on a date for that moment of ultimate violence; about a billion years ago.

While part of the ejected matter was falling back as astrophysicist Packer had proposed, it was insufficient for the accretion disc. The bulk

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of that came from gas in orbit, approximately normal to the axis of rotation. Every such orbit would have decayed by now, except that as an atom approached, the radiation turned it into plasma, which the electromagnetic fields accelerated. This slowed but did not stop inward spiraling. The disc had once been far brighter. In less than another billion years, it would be nearly extinct.

Even so, the quantity involved was immense. Guthrie's notion that a small, close-in companion had been destroyed could well be right. A cloud that was dense by cosmic standards must formerly have extended for tens of astronomical units. Perhaps that explained how new planets had formed. Or perhaps it explained how the remnants of old ones had moved inward. Geology on the ground ought to show which was true—or that both were false.

In either case, the surface that Guthrie and Demeter saw had to be comparatively fresh. Whether it grew incandescent from the crashing together of planetesimals or from a billow of fire that seared away its outer layers, an object this size would not cool off soon.

Despite that, elaborate formations decked it, where intricate electrical processes went on. The power clearly came from the disc, with possibly a geothermal component. The electricity could not be a direct result of resonance or induction. It was too complex, and it showed itself to have multitudinous points of origin, where energy was somehow concentrated. Yet the emissions were not messages. There were no transmitters, only leakages. Analysis revealed no codes; apparently the complexity was just a question of innumerable impulses in immense variety.

"What *is* it?" Demeter puzzled. "Why is it?"

"You know the Universe hasn't got any 'why,' " Guthrie said.

"Apart from what sentient life makes," she reminded him.

His being caressed hers. "Thanks for that," he said.

While they waited, they had not devoted themselves entirely to science. At intervals the mind must rest, it must dream. It must remember. From their private databanks, he and she evoked years reaching back through millennia—

—Anson Guthrie, whose Fireball Enterprises gave humankind its first real bridgehead beyond Earth and whose download led an exodus of rebels to Alpha Centauri. The need for an intelligence to guide and make strong the ecology they precariously sowed. Kyra Davis and Eiko Tamura, whose downloads went into the creation of Demeter Mother, tinged by what Guthrie recalled of his wife who died on Earth. The oneness she slowly gained with life, the knowledge and feeling, until at last she could do what had been impossible until then: download from Guthrie's neural network to a living body built around his genome. Her later shaping of a mate for him, who was her mortal self. And thus the opening of the stars, as ships bore quiescent programs to worlds prepared for new flesh. Lifespan after lifespan, the same souls

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housed over and over, now in organic form, now inorganic, but always aware and always, they hoped, growing toward a measure of wisdom—and multiple, the number of their avatars no longer knowable—

—I call this to your mind precisely because it is so familiar. Until we have ourselves been reborn, we shall not understand it, and not until we have had many rebirths shall we discern the full meaning of it. Meanwhile we should think upon it.

As nearly as disembodied minds may, Guthrie and Demeter relived the centuries of their love. I have glimpsed it in my father and my mother, who are among their incarnations. It is strong and it is strange; for beneath the ordinariness he wears like armor, he is the eternal hero, while she half remembers how again and again she has been a Life Mother. But the ways in which they shared it, these particular two who sought to the black hole, that concerns no one else.

In the end, after all the knowledge was in that could be gathered from aloft, he asked, "When do we send a robot down for a proper look?"

"Soon," she replied. "But not a robot. Telepresence would be too tricky, too clumsy, under these conditions and with this many unknowns. If nothing else, imagine what harm beyond repair we might do, bumbling around like that. No, I'll go."

"Huh? Wait just a flinkin' minute. I—"

Her merriment kissed him. "You haven't shucked your machismo yet, have you?" Soberly: "In case of trouble, I think you'd be better at mounting a rescue operation. You've been in more roughhouses." The soundless voice rang: "And I want to go, Anse!"

He felt the spirit of Kyra Davis, who once ranged the Solar System, smuggled him away from the enemies, waged the first space dogfight in history, and bore the first child born at Alpha Centauri. He yielded. "OK, if you insist on me hanging around up here gnawing the fingernails I haven't got, OK." The undertone went: *Come back to me, querida.*

Yes, if she perished, he could doubtless find another. Although they had brought no spare copies of themselves, for they had found the emotional dangers were too great (also to a download), plenty existed on every human-settled world. But the last branch-off from her line of descent had occurred almost four hundred years earlier, a vast gap in what they had done and known together. Nor could any such union resurrect this one Demeter. Her shade must forever be among those for whom he grieved.

There are still people who say we have abolished death. It is not so. It never can be so.

Speaking little more of what mattered most, the couple set about their prosaic preparations. Study the numerous kinds of map, choose a landing site, plan a schedule of exploration, plan for as many contingencies as were readily conceivable. Plant relay satellites to keep the ship in contact wherever it was. Have the appropriate robot transfer their braincases to appropriate machine bodies.

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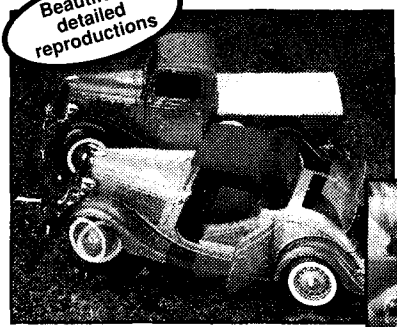

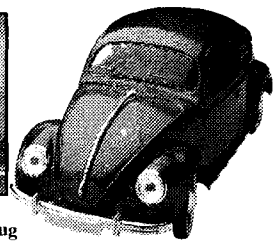

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His was gracile, six-armed, capable of swift movement and of steering equipment by remote control. Hers was twice the bulk, thickly shielded, four stout legs beneath a boxy torso, two arms ending in hands, four specialized limbs, sensory turret forward of the transceiver dish, powerpack good for a thousand strenuous hours. Once upon a time such an exchange of masculine and feminine shapes had been occasion for ribaldry; today they took it for granted.

He did generate his human face in his own turret and say awkwardly, "Have a care, sweetheart. *Buena suerte.*"

Her image smiled back. "Luck to you, too. Love you. *Adiós.*" She could not keep her fervor hidden.

He helped her exit, then stood by.

Riding a launcher down, she exulted. Again she was free, in open space. Stars encompassed her, more stars than darkness, a galaxy filled with their hundreds of billions. Dared she hope someday to know them all? And galaxies beyond them—They sang to her sensors, the multitudinous music of the spectrum. The launcher pulsed, accelerating. She recalled the feel of a horse between her knees, sunlit meadows, wind in her hair.

The planet swelled in sight until it occupied half the sky, no longer ahead but below. Crags rose jagged. Her destination came over the rim and she eased down to it. Unsecuring from the vehicle, she set foot on the world.

The site was a flat-topped, steep-sided block, like a small mesa, at the middle of a broad valley. Bare and swart, it overlooked crystalline figures clustered densely as far as vision reached. Mountains walled the horizon in the west, otherwise its arc met a deep purplish heaven. Auroras flickered overhead. Beyond them burned the accretion disc, near noon. Ripplings passed through its lens, lightnings forked, annihilation raged at the white heart and sent hard radiation cataracting. Gusts of air whined thin, dry, bitterly cold. Gravity dragged. When she tuned in, Demeter heard a susurrus of hidden electric tides.

"Landed safe," she called unnecessarily, out of ancient habit. To transmit every sensation would have required a broader band than was available, but Guthrie followed what she saw and did.

For an hour she simply peered at what lay around her. Thereafter she used instruments, optical and electronic. Finally she said, "I'm ready to start off."

"Are you sure?" he fretted.

"Sooner or later, I was bound to, wasn't I? Damn the torpedoes! But I will be careful, *querido.* I truly don't want to hurt something this wonderful."

Descent was tricky. She weighed over 40 percent again what she would have weighed at home. Stones rattled from underfoot and bounded downslope murderously fast. Drifts of grit slithered beneath her tread. Thrice she nearly fell. Her body could not tire, but when she reached the bottom her mind was breathing hard.

"Collect your wits, girl," she mut-

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tered, and focused vision on a thing that rose out of the ground before her. About a meter tall, it half suggested a shrub made out of enormous black snowflakes strewn with glitter, exquisite in a goblin fashion. Her touch found it scratchy—fractal, she ascertained—and very slightly vibrant. She could trace buried connections a short distance down into the soil, then their sign was lost in background noise. Roots? No, couldn't be.

The soil . . . it was not regolith: inorganic, anhydrous, but finer-grained. What chemistry had milled it?

Other businesses were mingled with a diversity of coralline and prismatic assemblages. Some were darkly ashen, some nacreous, occasional ones reflective as mirrors. Light played across their geometry, soft hues and shimmers, hard brilliances. A kilometer distant, solitary among them, a thing like an arabesque latticework reared globular, six meters high. Sparks flashed and trembled along its intertwined loops. A flaw of wind from that direction carried sounds that might have been made by glass chimes.

"Lovely, a fairyland," Demeter crooned.

Guthrie's response came harsh. "Easy, there. In the old stories, the genuine old stories, the fairy folk were not good to deal with."

"But we're the aliens here," she answered, and set forth. Her goal was the hollow globe. Not only was it unique, lines of electric current seemed to converge upon it and flow back from it.

She heard fragile structures snap, she sensed abrupt chaos where circuits broke asunder. No matter how cautiously she moved, this ponderous body of hers crushed and split what it passed through. "I'm sorry, I'm sorry," she said against all reason.

"Don't be," Guthrie counseled. "There's no dearth of 'em."

"But it feels—no, you can't feel what's happening, can you?"

"Pain? Come *on.*"

"Oh, no. Except—when I've been a mother, and a tree or a flower died—"

"You're not serious! Are you?"

She halted, sensing electricity fade away from her and make new patterns elsewhere, beneath the flaming lens. "Not really," she admitted. "It reminds me . . . but no, it isn't biological."

"How could it be? Whatever carbon atoms are in this stuff, they're secondary." He had no cause to lecture her about carbon, the single element capable of spontaneously joining into molecules complex enough to encode life. "Remarkable, yes," he added. "Unbelievable, if we didn't have it right on hand. How the hell could crystals like these ever grow? Conductive hookups, semiconductors, capacitors, maybe actual heat pumps—We thought we knew fairly well what the possible geochemistries are for every kind of planet under every kind of sun. We were wrong. God damn, but we were wrong! Here's a scientific revolution. And it's ours, honey, ours."

His excitement gripped her. She pushed on, heedless. Destruction crackled and shrilled louder, the nearer she came to the globe.

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It was not perfectly symmetrical, and ends curved from the periphery, as if it were growing outward. Nor was the interior quite empty; a three-dimensional spiderweb of thin strands crisscrossed and interwove. The light-flashes came off small pennons—metallic?—fluttering to every breeze. Where they struck together, they belled. Radio waves pulsed from the entirety, a hiss and throb echoed by underground electromagnetic surges. Deep below lay a node of matter close to absolute zero.

She stopped. It was Guthrie who spoke, "Judas priest," in marvel.

A member uncoiled from the lattice, swung around, and seized her.

At first she was merely astounded. The clutch encircled her turret and tightened. A second cable-thick limb whipped out, groped down her side, and closed on a leg.

Guthrie roared an obscenity. Demeter dug in her heels and strained backward. Her motors snarled. She felt the strain go through her captor, she saw the whole huge structure tremble. But it held her fast.

Her tool arms attacked with diamond saw and geologist's hammer. They barely bit. The cables were incredibly tough. Strands of perfect molecules, she thought wildly—fullerenes?—She pitched her weight to and fro. The cables drew her forward.

"Hang on!" Guthrie shouted. "I'm coming!"

He was above the opposite hemisphere. The computer in his body made its grim calculations. While the ship boosted, he gathered weapons.

The globe hugged Demeter against its lattice. Tendrils from within coiled about her, threadlike but soon enmeshingly many.

"Anse," she begged, "don't take reckless chances. Whatever happens, Anse, thank you, *mil gracias* for all our time—Oh—"

Inside the globe, something pushed out of the ground. A steel trumpet flower, she thought amidst the craziness. No, not really. As it stretched upward on its stalk, she saw that the petals moved and that their edges were serrated. By now she could do no more than kick a little.

The corolla swung back and forth. Its blind seeking found the target. Very slowly, it swayed toward her.

"I'm about to launch," Guthrie's voice tolled. "I'll be there in fifteen minutes."

"Don't risk yourself," she pleaded, knowing he would. "I'm only one download."

"You're my woman," he said. "If that thing hurts you, there's going to be a valley full of nothing but slag."

"No, Anse, *por favor,* you mustn't—"

A deep whistling went through her receiver. His vehicle had left the ship.

The corolla fumbled across her. When it found the turret, the petals drew shut, a hangman's cap. Her optics went black.

She felt the vibration as the petals cut through her shielding. It was like a scream.

I have heard that a download does not, cannot fear its extinction. But surely it can fear for those it loves, and sorrow at leaving them, and regret losing this miraculous Universe.

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by Charles Anton

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I think a part of Demeter withdrew to her past lives and sought peace in the recounting of how very much she had had. Another part of her still thought desperately, less about any way by which she might escape than about the whole of her plight, what had brought it about, what it meant.

And enlightenment came. We know this because of what she cried at the end.

A sensation pierced her, akin to agony. The corolla had ripped her shield open, pulled it apart, and started exuding a substance—an acid?—that attacked the casing beneath. Radiation from the disc struck the petals. Secondary showers rained out of them into her brain.

The ground shook. The noise of it toned in her. Guthrie had landed, meters away.

The corolla withdrew as if startled. Radiation flooded directly upon her. Particles and photons tore through picocircuits. Memory banks and logical functions degraded. Thunder blasted her awareness. It whirled down a vortex of night.

She saw Guthrie come striding. His body was meant for speed, not strength. The cables that held her could pluck him in pieces. He gave that no heed. In two of his hands an atomic hydrogen torch spouted flame. In two of his hands a laser projector made an energy sword. In two of his hands a sledge hammer swung, breaking a way to left and to right. So he came for her.

Lunacy ran wild. The past shattered and dissolved. With the last of herself Demeter wept, "Anse, darling, have mercy. This *is* alive—" Her mind fell from her as if into a black hole.

He said nothing to me of the battle he had waged except, "I got her free and took her back to the ship. I was her shield while we flew, of course."

Of course.

"Was she terribly hurt?" I breathed.

"Bad enough. I deactivated her and steered for home."

I mustered courage to ask, "She could have waited safely, couldn't she? While you did more science there?"

"I couldn't have," he answered. The bleakness thawed on his generated countenance. "Besides, alone, I'd've been less than half as effective as the two of us. I could easily have blundered into a situation where not even the ship survived. Better to cut our losses."

"How . . . how is she?"

"She's being restored. Many of her memories were undamaged. Most of what's gone can be replaced, along with the essential personality. I'll get her back."

Such is the primitive will to life on behalf of a beloved. In a download too. I think that otherwise we would not be peopling the stars.

"I'm glad," I said, in full honesty, and laid my hand over his. The sun had warmed it. Light danced on water, wind talked in leaves, a smell of wild thyme blew above the riverbank.

"What then?" I asked.

"We'll return," he said. "Better prepared, and not by ourselves. This calls for a major expedition."

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"It's certainly strange."

"More than strange."

My head snapped up at his tone. I stared at him.

"She knew," he said. "On the edge of death, she knew. Because she's been the Life Mother, again and again, clear back to Centauri. Through all the differences, she suddenly recognized the sameness."

I waited.

"That's a living planet," he said.

"But how can it be?"

"What is life? Don't we have to define it by what it does? It stores, copies, and transmits information; converts energy; recycles matter; maintains homeostasis; repairs and reproduces itself, grows, evolves. Don't I count as alive in this phase of mine? I do those things, one way or another."

"But you—you began as organic. Life has to."

"Probably. Only carbon has the properties to bootstrap up from the smallest molecules. However, once we'd developed technology, we built inorganic systems that're alive by any reasonable standard."

He was silent for a span before he went on—how quietly—"A vegetative life yonder, I suppose. Mainly, the electric currents are incidental, like the changing potentials in your cells. Although . . . it seems to have some kind of unity, integration. Local activity focused on the thing that grabbed my Demeter. Why did it? To save the valley from a trampling invader? Or was the action just a sort of tropism? How did it get the ability? I've wondered if maybe it processes ores. But then how are they passed on to it? An ecology—

"Sure, things must have been much simpler at first. Metals and silicates aren't very labile. I imagine, though, the radiation drives chemistry and crystallography hard. And an equivalent of catalysis—" He paused. "Does anything correspond to animals? And what might the evolution go on toward?

"We need to know."

"How could it have started?" I heard my voice thin and shivery.

"That's what we really need to know," Guthrie said. Each word struck after the next, like blows on a nail head. "Wreckage from a ship—or what?—how many ages ago? Or deliberate seeding? Were the crew organic . . . or were they not? We've never found spoor of any intelligent beings besides us and our creations. Until now—maybe. Remember, on Earth, it's the cybercosm that rules, minds more powerful than we believe anything in a biocosm can ever become. What are they doing? What may other cybercosms have been doing? We dream our dreams of the future. What may theirs be?"

He gazed past me, beyond the sky. "I told my Demeter the question 'Why?' is meaningless. I was mistaken. We all thought we'd learned some of the basics in the Universe. We were mistaken."

The stream rustled past us on its way to the sea.

Guthrie straightened at my side. Light poured across the image of his living face. "We've got to set that right," he said. ■

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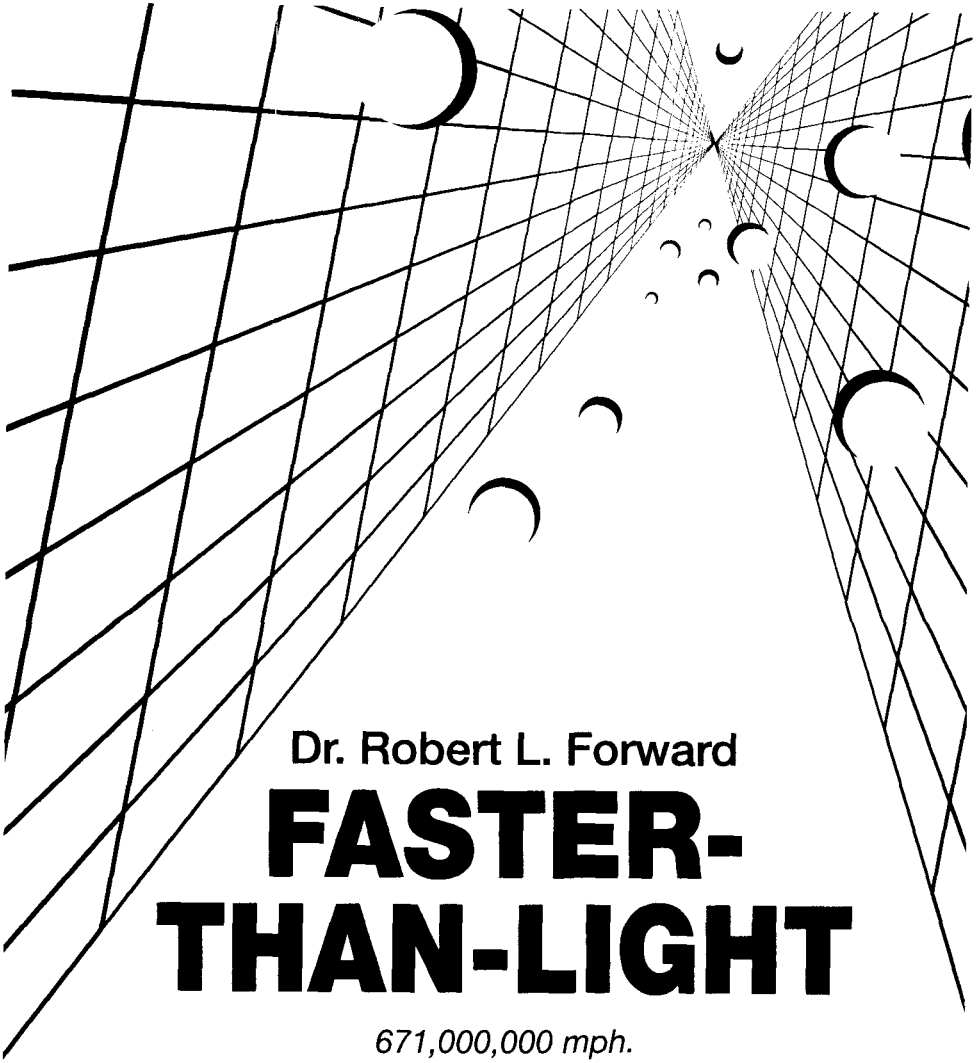

Dr. Robert L. Forward

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All scientists know, deep down in their souls, that they will never be allowed to break the ultimate speed limit. Yet, time and again, they are given clues by nature that perhaps—just perhaps—there might be a way to achieve faster-than-light (FTL) travel. The clues are many and varied, and any one of them just might be the chink in the armor of causality

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that will allow real scientists, not just those found in science-fiction stories, to not only travel faster-than-light, but also travel through time.

For it is one of the truisms of physics, that the existence of any sort of FTL phenomenon usually implies the existence of an analogous time travel phenomenon. In Einstein's special relativity theory, an observer moving at high speeds will see a faster-than-light spacecraft arrive at its destination before it left its starting point, in effect, traveling backward in time. In addition, many "wormhole" space warp concepts can be converted into a time machine by taking one of the mouths of the wormhole on a round-trip journey at high velocities to "younger" it compared to its stationary-mouth twin. Thus, a study of FTL phenomena must *necessarily* address the issue of the causality paradoxes caused by the existence of time machines.

To this date, FTL travel and time machines do not seem to be *forbidden* by the known laws of physics. (This, however, does *not* mean they are allowed.) There are many scientific publications which have looked into this question in considerable detail, and have been unable to find any violation of any conservation law or any other accepted laws of physics by FTL travel except the causality principle, which is not a physical law but a philosophical assumption. Even scientific studies of the problem of the violation of the causality principle by time machines seems to have resulted in reasonable sounding solutions, in both the classical and quantum domain, to the inevitable paradoxes that time machines raise.

To date, there is no strong experimental evidence for either FTL phenomena or time-travel phenomena—just hints. But in the process of trying to understand the observed possible FTL phenomena, we will probably learn more about the physical laws of the Universe, since the present laws seem to allow FTL and time machines.

FTL Phenomena in Theories

When it comes to predicting FTL and time-travel phenomena, our theories are not cooperating. Normally, one expects theories to be constricting—putting limits on what is possible. The experimentalists then come along and find some new phenomenon that can't be explained by the existing theory, which requires the generation of a newer theory with broader boundaries that allow the existence of the newly-found phenomenon. In the case of FTL and time travel, the tendency is the other way. There are many theories that seem to point to, or allow, the existence of FTL and time-travel phenomena, while the experimental evidence is lacking. The problem theories are not maverick ones, but include such well-respected and tested theories as the Einstein theory of mechanics at high velocities (special theory of relativity), the Einstein theory of gravity (general theory of relativity), quantum mechanics, and quantum electrodynamics.

Special Relativity: The very theory that gives us our ultimate speed law,

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the Einstein special relativity theory, also gives us a way to break that speed limit. The equations of the theory allow the existence of three types of particles:

• Bradyons—particles which have positive rest mass, which are created moving less than the speed of light, and which increase their speed as they gain energy. They cannot, however, increase their speed enough to reach the speed of light.

• Luxons—particles which have zero rest mass, which are created moving at the speed of light, and which always move at the speed of light no matter what their energy.

• Tachyons—particles which have imaginary rest mass, which are created moving faster than the speed of light, and which decrease their speed as they gain energy. They cannot, however, slow down enough to reach the speed of light. Although the rest mass of Tachyons is imaginary (we have no good idea what imaginary mass means), that causes no problems to the theory, since the tachyons are never at rest anyway, while the energy and momentum of the moving tachyons are calculated to be normal and positive, so the tachyons obey all the usual conservation laws of physics.

The special relativity theory, being *the* correct theory for the description of mechanics at high velocities, is also embedded in other theories. There it leads to other theoretical predictions of FTL phenomena. The Maxwell equations for the propagation of the electromagnetic waves, and the Schrödinger equations for the propagation of quantum probability waves, contain two solutions for the direction of propagation of the waves. One is the standard retarded wave solution which describes waves which travel from the past to the future. The theories, however, also allow an advanced wave solution, which describes waves that travel from the future into the past. These advanced waves could conceivably be used to send messages into the past. To no one's surprise, the advanced waves have not been experimentally observed. Since they have not been seen, their existence in the theory is conveniently ignored by both experimentalists and theorists, who use only the retarded wave solution. Yet . . . why is the theory allowing the existence of advanced waves if experimentally they do not exist? Certainly there is new physics to be found if we can understand the reason why the theory of fallible humans allows advanced waves while the reality of almighty nature forbids them. Attempts have been made to come up with models of reality that explain the non-observance of advanced waves. A number of theorists, including Wheeler and Feynman, and *Analog* Alternate View columnist John Cramer, have proposed models involving combined and coordinated advanced and retarded waves to explain why advanced waves are not seen. Some of these models, if true, could conceivably be used to provide FTL communication.

General Relativity: The Einstein gravity equations are replete with outrageous solutions describing ma-

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chines that allow not only FTL travel through wormholes in spacetime and tunnels through space, via hyperdimensions and other universes; but also time travel using all those machines plus others.

- Black Holes: Black holes by themselves (despite the claims of Hollywood) will not do as space tunnels. The black hole equations describe a wormhole in spacetime that leads to a "white hole" exit "somewhere else." If the black hole is large enough (galactic in size), you can pass through the event horizon of the black hole without damage. But, the mass that formed the black hole is clogging up the throat of the wormhole, and the mathematical equations describing the space inside the event horizon show that even the most powerful spacecraft imaginable cannot avoid hitting the mass and being destroyed.
- Reissner-Nordstrøm Chargewarp: Adding charge to a black hole allows a powerful enough spacecraft entering through the event horizon of the Chargewarp to maneuver around the charged mass at the center to get to the "white hole" exit. The exit universe, however, is not the one the spacecraft left. To use a Chargewarp for FTL and time travel, you would need to find another Chargewarp in the new universe that connects back to our Universe.
- Kerr Ringwarp: To make a Ringwarp requires manipulating a rapidly rotating star (typically 100 times solar mass) while it is trying to collapse into a black hole. Instead of allowing the star to contract into a spinning oblate sphere, you force it to collapse into a dense rotating ring, empty in the center. The mathematical equations for this massive ring configuration describe two infinite regions connected through the hole in the ring. One region is this Universe and the other is a hyperuniverse where matter is negative and time is spacelike. The Ringwarp can be used as both a space warp and a time machine. Two-way use, however, requires that the ring rotate with a peripheral velocity of the speed of light, which is not possible. (Don't worry, the answer to that problem is in the next section.) The Ringwarp also has other "engineering" problems that would require a highly advanced technology to overcome, such as: the means for forcing the formation of the ring shape, the stability of the ring during the passage of a spacecraft, and the generation of radiation from instabilities in the fluctuations of the vacuum induced by the Ringwarp.
- Kerr-Newman Charged Ringwarp: Adding charge to a rotating massive ring allows the formation of a two-way space warp and time machine while requiring a peripheral velocity slightly less than the speed of light. The machine still has the other "engineering" problems of the Kerr Ringwarp.
- Morris-Thorne Field-Supported Wormhole: This is a "tunnel" through space from one point in space to another. Its construction does not require dealing with black holes. It exhibits no strong tidal effects or other nasty properties like instability and radiation. The construction of the

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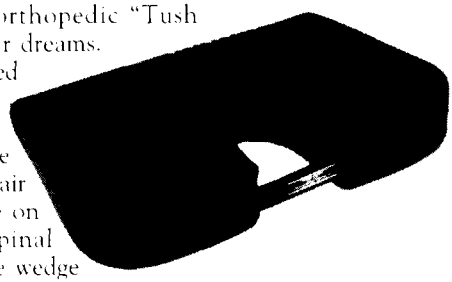

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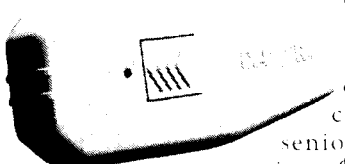

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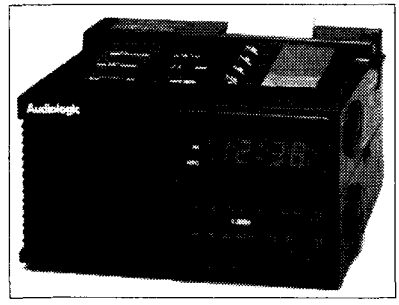

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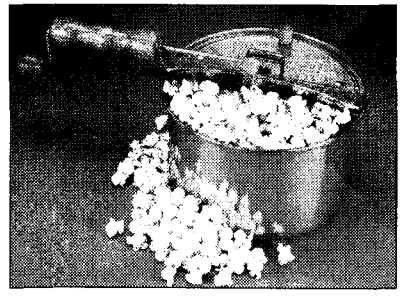

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machine does require that the wormhole be held open by an "exotic" field, a field that has an energy density less than its tensile strength. Normal electric and magnetic fields have an energy density that is exactly equal to the tensile strength of the field. Superstrong electric fields can be used to hold up most of the tunnel, but right at the throat an exotic field must be used. Such exotic fields exist. The "Casimir vacuum" between two metal plates is one such field, and Thorne and his students have "designed" a wormhole that uses the Casimir vacuum as the required exotic field. The smaller the throat, the higher the negative mass density needed in the field to hold open the throat. For a 10-meter-throat, the density is minus 10^{22} g/cc. For a 20-kilometer-throat, the density is minus 10^{14} g/cc—neutron star density. To get down to the density of negative water, the throat would have to be millions of light-years across. The method of "growing" the wormhole from a sub-yoctoscopic (yocto = 10^{-24}) primordial quantum-foam wormhole is not obvious.

The wormhole can easily be turned into a time machine by just taking one mouth of the wormhole on a short round-trip relativistic journey to make it younger (say by one week) than the stay-at-home mouth. [See Thorne, 1994 for a technical discussion, and Forward, 1992 for a fictional description.] Once the two mouths are brought back together side-by-side, then to travel to the future, you enter the younger mouth and exit the older mouth one week later than the time you entered. To travel to the past, you enter the older mouth and exit the younger mouth one week earlier than the time you entered. You can repeat the process, going back in time in weekly jumps, until you reach the time at which the time machine was first formed.

- Alcubierre Spacetime Inflation Warp Drive: The general relativity equations can be used to make a FTL warp drive reminiscent of the warp drive on the Starship *Enterprise*. Strong exotic fields with negative energy density are used to "inflate" the space in back of a starship, increasing the effective distance between the starship and its departure point, and to "deflate" the space in front of the starship, decreasing the effective distance to its arrival point. By properly shaping the exotic fields, the strong tidal effects from the superdense exotic field can be made small near the starship. (Creating and shaping the necessary exotic fields are "engineering details" for some future advanced technology to solve.) Such superluminal expansion of spacetime has been postulated to have occurred during the early "inflation" phase of the Big Bang. Objects being separated by such an inflation process are not going faster-than-light in their local regions. The enormous effective speed of separation comes from the expansion of spacetime itself.

Quantum Mechanics: The theory of quantum mechanics contains many unusual concepts, such as particle creation and annihilation, quantum tunneling, quantum jumps, instantaneous collapse of the wave function

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of a system, and the continuing "quantum connectedness" of distant particles that have interacted in the past. Many present models of quantum connectedness seem to involve an instantaneous-action-at-a-distance phenomenon with potential for allowing the FTL transfer of information. There are many different "interpretations" or "models" of what the equations of quantum mechanics mean from a physical point of view. Some examples are the:

- Copenhagen Reality-Created-by-Observation Model: (Example: Schrödinger's cat in a box is neither dead nor alive until someone looks.) The process of observation (measurement) collapses the wave function of a system from a variety of probabilities to a certainty. This is the interpretation accepted by most physicists, but there are many variations.
- Bell Instantaneous Quantum Connectedness Model: This model is an amplification of the Copenhagen model. When two quantum particles, A and B, interact briefly, then move apart a great distance, the mathematical probability waves that represent A and B do not separate cleanly, but remain "phase entangled." When the wave that represents particle A is changed, a corresponding change occurs instantly in the wave that represents B. Bell's Theorem shows this superluminal "Instantaneous-Action-At-A-Distance" connection between two phase-entangled systems is not a mere theoretical artifact, for it produces measurable experimental results that are different than those produced by other models. Experiments to verify Bell's Theorem have produced results that cannot be explained by subluminal connections alone. No one, however, has come up with a workable scheme that can use the instantaneous collapse of a wave function to transmit information (or people) faster than light. In fact, there are strong theoretical arguments that it can't be done. The theory shows that although each random quantum collapse event involves superluminal connections between particles A and B, the superluminal effects become unobservable when attempts are made to nonrandomly affect a pattern of many random events in order to transmit information.
- Everett Many-Worlds Model: This model gets around quantum uncertainty paradoxes by assuming that all possible results take place during the collapse of the wave function of a system, and the Universe duplicates itself to accommodate all results. This model solves some of the paradoxes of half-dead cats, but at the expense of creating an infinitely multiplying multitude of universes where *everything* is possible.
- Hidden Variables Model: This model postulates some new force that does *not* act faster than light, is "hidden" from present physics, and which causes things to happen at a distance as if there was a FTL connection. This model is now felt to have been proved wrong by the experiments backing the Bell Instantaneous Quantum Connectedness Model.
- Cramer Transactional Model: This model, by *Analog* Alternate View col-

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umnist John Cramer, postulates that every quantum event involves an exchange of advanced and retarded wave solutions to the Schrödinger equation. Since this model uses advanced waves, it has obvious FTL implications.

I would say that it is a general consensus of physicists that although the presently accepted "Copenhagen" model of quantum mechanics can predict accurately what will happen in the real world, it is poor at giving a physical "picture" of what is going on. We all hope that someone will come up with the "real" model of quantum mechanics that provides not only the correct mathematical answer, but a better physical picture of life in the small. In the meantime, the accepted and experimentally tested models seem to require the existence of FTL connections between particles separated by great distances. Although the theories seem to conspire to prevent us from using those FTL connections to transmit anything faster than light, the fact that those FTL connections exist in the theory is interesting.

Quantum Electrodynamics: The theory of quantum electrodynamics describes the microscopic behavior of electricity and magnetism. It is one of the more successful physical theories, since it has been checked experimentally many times and found to be accurate. In quantum electrodynamics, a region of space devoid of matter is divided up into a large (infinite) number of modes of potential oscillation for the electromagnetic field. The state of the electromagnetic field in that space is defined by counting the number of photons in each mode. The "vacuum" state is defined as that state where there are no photons in any of the modes. But the vacuum state is not empty, for according to quantum electrodynamics, each mode of oscillation, even when the space is at absolute zero, has in it a zero-point oscillation with an energy equal to "half" a photon. This residual electromagnetic field produces fluctuating electromagnetic forces that have experimentally observable consequences.

One effect of the electromagnetic vacuum fluctuations is called the Casimir force. The Casimir force is a short range attraction between any two objects caused by the presence of the electromagnetic fluctuations in the vacuum. This effect is also known as "surface tension," "surface energy," and "van der Waals forces" between uncharged atoms and objects. A calculation by Casimir of the force between two conducting plates showed that the conducting plates restrict the number of normal modes that can exist in the vacuum region between the plates. Although there are an infinite number of modes between the two plates, that infinity is smaller than the infinite number of modes that would be allowed if the plates weren't there. In a straightforward calculation of the number of normal modes and the zero-point energy in those modes, Casimir showed that the region of vacuum between the plates would have less energy than the normal vacuum, and would have a negative energy density that

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was proportional to the third power of the spacing between the plates. There thus would be an attractive force between the plates that was proportional to the fourth power of the spacing. The force is independent of the material in the conductors. Experimental measurements of the Casimir force have been carried out a number of times with varying degrees of success. The closest separation distance obtained without the plates touching was fourteen angstroms (about five atoms). At fourteen angstroms, the measured force was over ten tons per square meter!

According to the theory of quantum electrodynamics, the speed of light from plate to plate in a Casimir vacuum should be faster than the speed of light in a normal vacuum by a small amount (about 10^{-12}). So we have yet another well-accepted and tested theory that predicts FTL phenomena.

Other Theories: In addition to the more accepted theories, there are other, more speculative theories that also predict FTL phenomena and time machines.

- Penrose Twistor Theory: Penrose has devised an 8-dimensional theory for the structure of spacetime, partially based on the nice mathematical properties of complex numbers. One prediction is that if the space between Earth and Mars is sufficiently "distorted" in 8-D "twistor space," then the 4-D physical space associated with that portion of twistor space "disappears," and Mars is now right next to Earth, just a short rocket jaunt away. This is not really FTL travel, since the disappearance of space will probably happen at light speed, but it achieves the same result. Making twistor theory match up with observed experiments has not been notably successful, and not much has been heard about twistor theory from Penrose lately.
- CPT Symmetry Theory: This theory states that there should be a symmetry of behavior in experiments where charge, parity (mirror-image orientation), and time are interchanged. Experiments, however, have found that asymmetries exist.

The decay of the neutral kaon into two pions is predicted to take place at a different reaction rate with time than the combining of two pions into a neutral kaon, indicating a time-asymmetry bias of spacetime. Could this be a handle on time that could lead to time travel?

Parity symmetry would imply that luxons (photons and neutrinos) could exist in either right-handed or left-handed versions (direction of spin compared to direction of motion). Photons exist in both polarizations. Neutrinos, however, are always generated with left-handed polarization, while antineutrinos are right-handed. Does this indicate that space has a left-handed "twist" in this region of spacetime or that neutrinos exist in a different "space" than photons?

- Superstring Theories: Superstring theories are the latest theoretical hope for finding the "Theory of Everything." In these theories, the elementary particles are supposed to be Planck-length strings instead of

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points. The different elementary particles are then represented as "modes of vibration" of the string. Nearly all superstring theories predict the existence of FTL modes, which imply the existence of tachyonic particles. This again indicates that FTL phenomena are ubiquitous in physical theories.

In the 10-D and 26-D versions of superstring theories, the extra dimensions are "rolled up" so that we don't observe them. This leads to speculations about using these dimensions for FTL travel. One could "unroll" a rolled-up dimension, use it to travel in a tachyonic mode, then roll it up. If dimensions in general can be rolled up, then it might be possible to roll up one of our three space dimensions, rapidly move to a new point in the rolled up dimension, then unroll it.

- Cosmic String Theories: These are galaxy-sized linear "discontinuities" in spacetime that are postulated to have formed during the Big Bang. According to some Cosmic String Theories, if these hypothetical cosmological discontinuities in spacetime pass each other fast enough, they can temporarily produce a time machine.
- Point Particles: According to the curved-space mathematics of the Einstein general relativity theory, black holes have a finite circumference, but zero radius and zero volume. One could say they are point particles. Electrons, muons, and quarks also seem to be point particles. For example, the radius of the electron must be less than 10^{-20} cm (10^{-10} the size of an atom) to agree with the *g*-factor measured on trapped individual electrons. How can a particle in 4-D spacetime have zero dimensions? Are point particles quantum black holes? And since these supposedly point particles have mass, spin, and charge, they should produce mathematical infinities—charge singularities and angular momentum singularities as well as mass singularities. Singularities are not allowed in the real world of nature, so at what size are point particles no longer points?

Many relativists have pointed out that the ratio of the angular momentum to the magnetic field is the same for both the electron and the maximal Kerr-Newman solution to the Einstein General Relativity equations. Theorists have replaced the proton in a hydrogen atom with an equivalent Kerr-Newman source generated using the general relativity equations, and calculated the hyperfine structure of the resultant atom. It agrees with experiments on real hydrogen atoms to ten places *with the exception of an exact factor of two.* Do we need quantum gravity to understand elementary particles? Is nature trying to tell us something?

- Spin Space: Elementary particles have a property called spin. Although spin has some of the properties of classical angular momentum, it is not angular momentum. It is something else that leads to bizarre experimental results. Spin ½ particles, such as neutrinos, electrons, protons, and neutrons, are called fermions. Integer spin particles, such as photons and pions, are called bosons. Fermions seem to have a tendency to avoid each other, and obey a different sta-

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tistical law than bosons, which seem to have a tendency to clump together. The statistical laws for fermions and bosons are not only different from each other, but they are also different from the classical statistical laws that govern the toss of a coin or the motion of a ball in a roulette wheel. (A bosonic coin would have an increased tendency to fall heads-up if there were a number of coins showing heads already on the table.) There is something even stranger about spin ½ particles, however, that indicate that they live in a different "space" than we do. You have to turn them over twice to turn them over! Ultracold beams of polarized neutrons, which have spin ½ and a magnetic moment that allows you to manipulate them with magnetic fields, were split into two beams. One beam was rotated using magnetic fields and then interfered with the other beam. The neutrons had to be rotated 720 degrees through physical space before their spins were realigned in the original direction in order to cause interference. Is there such a thing as spin space? Is nature trying to tell us something?

Experimental Evidence for FTL Phenomena

There are three areas where there is some experimental evidence that indicates the possible existence of FTL phenomena: the firm proof of the FTL quantum connectedness of widely separated "entangled" particles, the possible observation of tachyons in cosmic ray showers, and the probable measurement of an imaginary rest mass for neutrinos.

FTL Quantum Connectedness: As discussed earlier, when two quantum particles, A and B, interact briefly, then move apart a great distance, the mathematical probability waves that represent A and B do not separate cleanly, but remain "phase entangled." When the wave that represents particle A is changed, a corresponding change occurs instantly in the wave that represents B. The actual experiments to demonstrate this involved generating two photons at the same time, using a process which causes them to both have the same polarization, although the exact state of polarization of the two is unknown until a measurement is made on one of them. These two "entangled" photons are then sent off in opposite directions. At one end of the laboratory, the polarization of one photon is measured, which instantly causes the polarization of the other photon at the opposite end of the laboratory to be "known" rather than "unknown." A photon with a "known" polarization reacts differently to a polarizer at various orientations (either passes through or is reflected) than a photon with an "unknown" polarization. By randomly varying the orientation of polarizers at different ends of the laboratory, measuring the results, and comparing them with Bell's Theory, the experimenters proved that there was a coupling between the two distant photons. The measurements on the two widely separated photons were made in time intervals that were less than the light travel time across the laboratory, showing that what-

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ever the mechanism causing the coupling between the two distant photons, it operated at a speed that was faster than light. These experiments prove that FTL phenomena exist in quantum mechanics. So far, however, no one has found a way to use this FTL coupling to transmit either objects or information faster than light.

Tachyons in Cosmic Ray Showers: In the 1970s and '80s, some experiments were carried out to detect tachyons produced in an ultrahigh-energy cosmic ray shower. When an incoming cosmic ray particle hits an air molecule in the upper atmosphere, it produces a shower of particles of many different kinds. The idea behind the experiment was that, along with the millions of ordinary bradyon particles produced, all of them with so much energy that they are moving at speeds just below the speed of light, a small number of tachyon particles might be produced with so much energy they would be moving just *above* the speed of light, rather than many times the speed of light, which are the normal speeds for high energy tachyons. These high-energy tachyons would be moving slowly enough that they would stay in the detector long enough to activate it. Three of the experiments, which collected thousands of shower events over periods ranging from months to years, produced positive results. In a significant number of shower events, the detectors noticed the arrival of particles some 50-70 microseconds before the main shower front arrived. Unfortunately, other similar experiments didn't notice such an effect, so the positive results have not been accepted. The experiments have not been repeated to date.

Imaginary Neutrino Rest Mass: There are three types of neutrinos—the electron neutrino, the muon neutrino, and the tau neutrino. The rest mass of all three has been assumed to be zero. Recent measurements on the electron neutrino and the muon neutrino, however, have been coming up with negative values for the rest mass squared, which implies that these neutrinos might have imaginary rest mass. If they have imaginary rest mass, then they could be tachyons.

Measurements of the electron neutrino rest mass are carried out by measuring the end point of the energy spectrum of the electron emitted in the decay of tritium. (The neutrino, which can pass through lightyears of lead without interacting, is essentially undetectable.) Tritium (a hydrogen atom with one proton and two neutrons in its nucleus), decays into helium-3 (with two protons and one neutron), plus an electron and an electron neutrino. Since the helium-3 nucleus is so much heavier than the other two particles, it hardly moves, and it is the electron and the electron neutrino that share nearly all of the energy released in the reaction. Sometimes the neutrino gets most of the energy, leaving the electron with almost none, sometimes the electron gets most of the energy. The experimenter plots the spectrum of electron energies that are observed and tries to determine the low-energy

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end point. If the neutrino has a rest mass, then this end point on the energy spectrum has an abrupt termination instead of tailing off smoothly to zero. For various experimental reasons, the quantity that is calculated from measuring the minimum energy seen in the electron spectrum, is not the rest mass of the neutrino, but the *square* of the rest mass. The experiments have been getting more and more precise as time goes on, and instead of the expected value of zero, the square of the electron neutrino rest mass seems to be negative. The reported values are:

(1986) − 158±253 eV^2

(1991) − 147±109 eV^2

In the 1991 experiment, the "signal level" is 1.35 times the estimated error—interesting, but not convincing. Recent experiments at Los Alamos National Laboratory (LANL), however, have produced the same results, but with a signal level that is six standard deviations above the estimated error level or a confidence level of 99.9999% + that the correct value is not zero. This implies an imaginary rest mass of the electron neutrino of about $12 \cdot i$ eV ($1.8 \cdot i \times 10^{-36}$ kg or $2 \cdot i \times 10^{-6}$ times the mass of an electron).

It is interesting to note that if the experimenter at LANL had achieved a result where square of the electron neutrino rest mass was non-zero and *positive*, then he would have trumpeted his results in not only the science journals, but in all the newspapers and magazines, as he would be a shoo-in for the next Nobel prize. Although the neutrino is supposed to have a zero rest mass, a positive rest mass is acceptable in the existing theories of the neutrino, and would be the answer to many puzzling questions about the interaction of neutrinos with the rest of the Universe. An imaginary neutrino with its possible FTL properties, however, is not acceptable to the scientific community, since it dredges up unwanted associations with science fiction concepts such as the FTL warp drive of the Starship *Enterprise*, and time machine paradoxes. The experimenter is afraid that his experimental setup has some unknown error source that is creating this outrageous result, and he doesn't want to publish it for fear of being proved wrong later.

Similar results seem to be coming from measurements of the muon neutrino rest mass. Muon neutrinos are generated during the decay of a pion particle into a muon particle. By using an elementary-particle track chamber to measure the incoming energy and momentum of a charged pion and the outgoing energy and momentum of the charged muon, it is possible to calculate the energy, momentum, and rest mass of the unseen muon neutrino. Again, the quantity calculated is the square of the muon neutrino rest mass. The results to date are:

(1973) − 0.29 ±0.90 MeV^2

(1980) + 0.102±0.119 MeV^2

(1982) − 0.14 ±0.20 MeV^2/c^4

(1984) − 0.163±0.080 MeV^2/c^4

The latest measurement is two standard deviations above the estimated error level, which gives a confidence level of 95% that the correct value is not zero. This implies a muon neutrino imaginary rest mass of about

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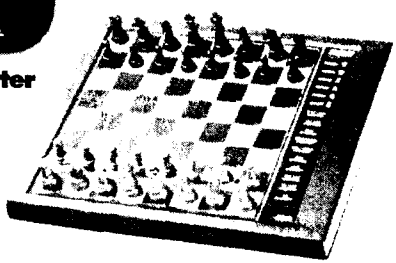

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$0.4 \cdot i$ MeV/c^2 ($7 \cdot i \times 10^{-31}$ kg = $0.8 \cdot i$ electron mass).

There is definitely something interesting going on, but whatever it is, it is being swept under the rug by most physicists who regard these experimental results as an embarrassing anomaly rather than an opportunity. This leads one to wonder what other experiments could be done to measure the mass of the various neutrinos—experiments with different experimental conditions that might not have the same hidden error sources that are causing the assumed anomalous results.

There is strong evidence that the number of neutrinos being emitted by the Sun is one-third that predicted by theory. Could it be that the tachyonic neutrinos are moving too fast for the detectors? An alternate explanation for the lack of solar neutrinos is that the neutrinos "oscillate" from being one type of neutrino to another with time. The neutrino oscillation theories require non-zero rest mass for the neutrino. What do neutrino oscillations mean if the rest mass of the neutrino is imaginary?

But before we accept the idea that neutrinos might be tachyons, we must be careful and think through all the implications of a tachyonic neutrino. There are other effects of neutrinos on the details of the structure of the Sun, the Galaxy, and the Big Bang, that require rethinking if the neutrino mass is not zero. In addition, there probably should be other things happening if the neutrino has an imaginary rest mass. Only if those things are also observed can we say that the neutrino is a tachyon.

Possible Experiments That Could Be Done

In addition to repeating and refining the experiments mentioned in the previous section, there are other experiments that could be done.

Casimir Vacuum Experiments: It was pointed out previously that according to the theory of quantum electrodynamics, the speed of light from plate to plate in a Casimir experiment setup should be faster than the speed of light in vacuum by a small amount (parts in 10^{12}). This is a very difficult experiment, considering that the distance over which the measurement must be made is in the direction between the plates, which is typically measured in nanometers. This potential FTL phenomenon may be measurable, however, if the experiment were designed so that the speed measurement was turned into a frequency measurement.

If the speed of light between Casimir plates is greater than c, then, since rest mass is $m = E/c^2$, does this mean that the rest mass of a particle in a Casimir vacuum is less than its rest mass in normal vacuum? Since the velocity of light between Casimir plates is anisotropic (greater than c normal to the plates but c parallel to the plates) does this also mean that the rest mass is anisotropic to parts in 10^{24}? Prior null experiments on the anistropy of inertial mass were accurate to parts in 10^{23}. Could those techniques be applied to this setup?

Black Hole Observables: If a nearby black hole is found, and it is deter-

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mined to be a copious source of neutrinos, then this would prove neutrinos are tachyons, since only a faster-than-light tachyon can escape a black hole. This may also explain why we have not seen the expected gamma-ray explosions of microscopic-sized, asteroidal-mass primordial black holes undergoing their final stages of Hawking radiation evaporation.

Wormhole Observables: Even though it may not be possible for us to build a Morris-Thorne wormhole with present technology, they may have been formed during an early phase of the Big Bang when a Planck-sized quantum fluctuation wormhole was threaded with an exotic field. If the wormhole participated in the general inflation of the Universe, then it would be larger in size and mass now, perhaps even large enough to observe. Three possible observables of such an object would be the appearance or disappearance of an object through one of the mouths of the wormhole, the strange effects on nearby masses of the repulsive gravity field of the negative energy density exotic field holding the wormhole open, and the gravitational lensing of background starlight by the negative gravity field of a wormhole mouth.

There are presently three ongoing (and successful) searches for gravitational lensing effects on distant stars (typically a star on the other side of the Galaxy or in the Large Magellanic Cloud), as dark massive bodies in the halo of our Milky Way Galaxy move between the Earth and the distant star. These postulated dark bodies are called MAssive Compact Halo Objects or MACHOs. The bending of the starlight passing near the MACHO causes it to be concentrated behind the MACHO. When the star, MACHO, and Earth are nearly in alignment, an observer on the Earth will see a smooth increase in the observed brightness of the star by factors of three to ten over a period of days to months, followed by a smooth decrease with exactly the same shape. The shape and amplitude of the peak will be the same in the blue and the red. These requirements help distinguish a MACHO brightening from other things that could cause a temporary increase in the observed brightness of a star. To date a number of candidate MACHO events have been seen. Since such a search is going on, it would be simple for those doing the search to also look for the lensing effects of Gravitationally Negative Anomalous Compact Halo Objects (GNACHOs) such as large primordial wormhole mouths.

Recently a workshop on FTL phenomena was held at the NASA Jet Propulsion Laboratory in Pasadena, California. It was sponsored by Gary Bennett of NASA headquarters. Six of the workshop participants, four of whom are *Analog* writers, prepared a paper discussing a search for GNACHOs. [For more information on the NASA FTL Workshop itself, read John Cramer's Alternate View columns entitled "NASA Goes FTL," in the Mid-December 1994 and February 1995 issues.] The paper, "Natural Wormholes as Gravitational Lenses" by John G. Cramer,

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Robert L. Forward, Michael S. Morris, Matt Visser, Gregory Benford, and Geoffrey A. Landis, has been submitted to *Physical Review Letters*. The abstract reads:

"Visser has suggested a type of flat-space three-dimensional wormhole that plausibly could have been formed during the inflationary phase of the early Universe. Of the wormhole's two mouths, the mouth in the region of higher mass density would tend to accrete mass, causing the other mouth to develop a sizable *negative* mass with unusual gravitational properties. We have considered the lensing of such a gravitationally negative anomalous compact halo object (GNACHO) and conclude that it will lens starlight from background stars to provide a characteristic profile that is distinctive, readily observable, and qualitatively different from that recently observed for massive compact halo objects (MACHOs) with positive mass. We recommend that MACHO search data be analyzed for evidence of GNACHOs."

Interestingly enough, the analysis shows that the lensing effect of a GNACHO is not that of a diverging lens (as one might first assume). Instead, the gravitational field of the GNACHO acts to push the incoming starlight away in such a manner as to form a paraboloid-shaped "light caustic" something like a "shock front," where the light rays deflected at different distances from the GNACHO pile up along the "front" leaving a paraboloid-shaped shadow. Thus, as the GNACHO passes in front of the star, there is first a rise in the observed intensity, a sharp cutoff to zero intensity as the observer enters the shadow zone, then a sharp rise to another peak as the observer leaves the shadow zone, followed by a more gradual falloff. Thus, the effect of a GNACHO on the observed intensity of the distant star image consists of both magnification (near the edge of the caustic) and demagnification (zero intensity in the shadow zone). The whole process is expected to take many days to months, similar in time scale for the observed MACHOs. The GNACHO signal is distinctly different from the MACHO signal, and for some values of the "impact parameters" the magnification of the star intensity by the GNACHO is actually higher than that of a MACHO of similar mass magnitude.

To summarize, our theories give us plenty of encouragement that FTL phenomena and time travel could exist, despite the causality problems this could produce. While our experiments to find usable FTL phenomena have not been conclusive to date, there still are experiments that need to be done, to clarify old results and look for new effects.

So, although we scientists know, deep down in our souls, that we will never be allowed to break the ultimate speed limit, the existence of these theoretical and experimental hair-line cracks in the light barrier encourage us to continue to try. We keep our right foot pressed hard against the floorboard, pushing our scientific apparatus to ever higher speeds, one eye in the rear-view mirror, checking for the Einsteinian

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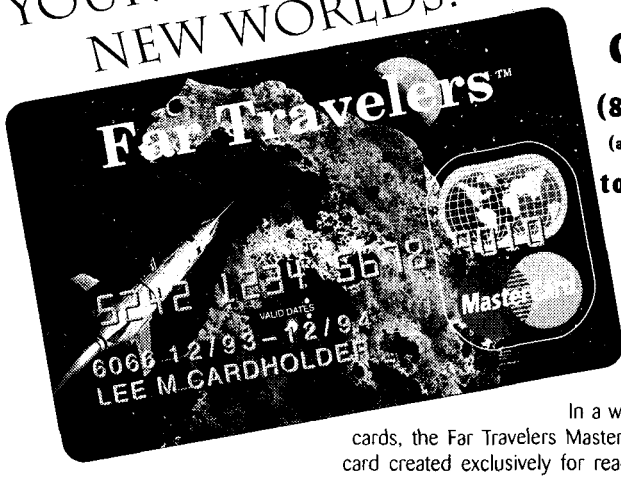

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"speed cop" behind each billboard that we pass, hoping against hope that one of these days we will get away with it, and break through the last speed barrier between us and infinity—in both space and time. ■

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Wise living consists, perhaps less in acquiring good habits than in acquiring as few habits as possible.

—Eric Hoffer

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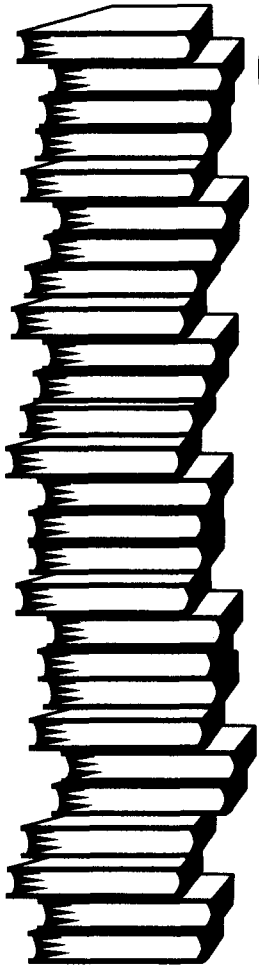

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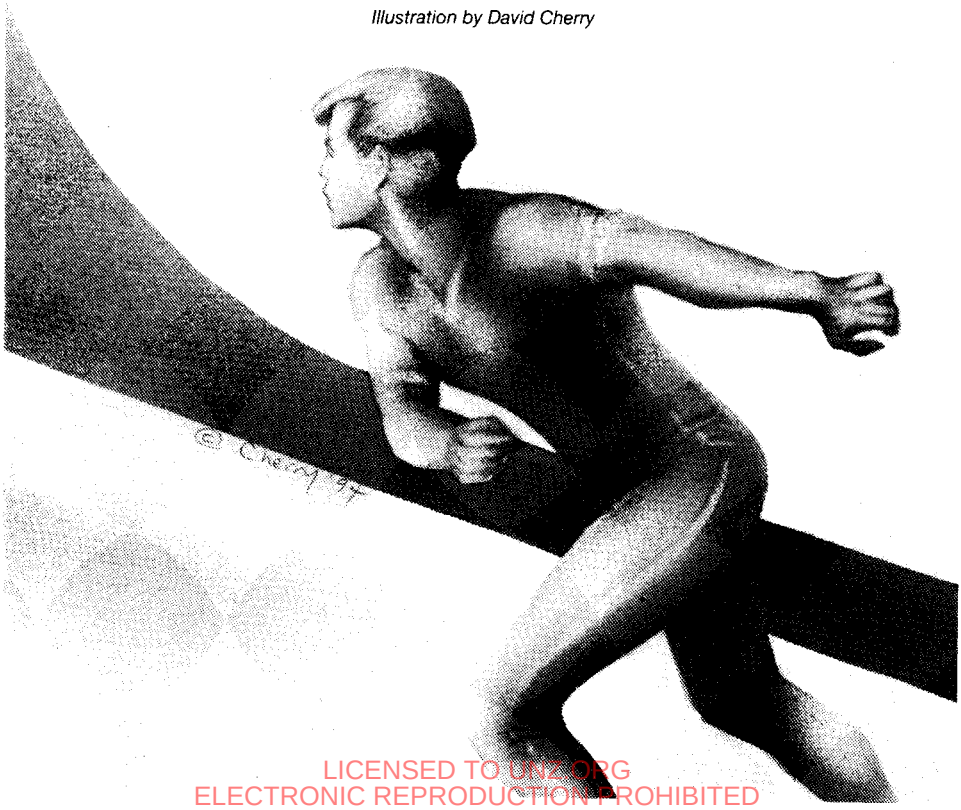
Robert J. Sawyer

HOBSON'S CHOICE

Conclusion

Important subjects aren't always easy to learn.
Oneself, for example. . . .

Illustration by David Cherry



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Synopsis

December 2011: Detective **Alexandria ("Sandra") Philo**, *thirty-six, of the Metropolitan Toronto Police is in the hospital dying from radiation damage inflicted by an illegal weapon called a* beamer. **Peter Hobson**, *Ph.D., forty-two, president of Hobson Monitoring Limited, a biomedical engineering firm, bursts into her hospital room. Sandra is shocked: she believes Peter, a prime suspect in some recent murders, is the man who arranged for the attack that has mortally wounded her. Peter protests his innocence, and tells her of a new technique, pioneered by Peter's best friend, artificial-intelligence specialist Dr.* **Sarkar Muhammed**, *to scan every neural net in a human brain and produce an exact duplicate of the subject's mind inside a computer. Using this technique Peter says that three computer duplicates of his own mind were created—and one of them, he claims, was responsible for the murders. Even though Sandra is dying, Peter says there's still a way for her to catch the murdering simulation.*

Flashback to January 1995: Peter Hobson is now just twenty-six, a biomedical engineering student whose course work requires him to log some real-world experience with medical monitoring equipment. He's given the chance to operate the EKG during an operation to harvest for transplant the heart of a teenaged boy who had been in a severe motorcycle accident. But during the harvesting procedure, the supposedly dead boy gasps on the operating table.

Peter learns that bodies to be used for organ harvesting are never taken off life support. He realizes that in a very real sense the teenaged boy didn't die until the moment the transplant surgeon removed his heart from his chest.

Flash-forward to 2011: To this day, Peter is haunted by nightmares about the supposedly dead boy waking up on the operating table. Because of this, he's been working on a supersensitive EEG that he hopes will be able to precisely determine the actual moment of final, irreversible death. Meanwhile, Peter has also become intrigued by a new nanotechnology process that claims to provide practical immortality for human beings.

Peter is now married to a woman named **Cathy**, *who, although she has a degree in chemistry, works in a noncreative position for Doowap Advertising. Out of the blue one day, Cathy tearfully confesses to Peter that she has slept three times now with a loutish office Lothario named* **Hans Larsen**. *Peter is devastated, crying for the first time in decades. Cathy goes for counseling, and learns that her infidelity might be the result of the cold, uncaring upbringing she'd had at the hands of her father,* **Rod Churchill**, *now a retired gym teacher.*

Peter tests his superEEG on **Peggy Fennell**, *a woman dying of old age, and discovers to his astonishment a complex, cohesive electrical field moving through her brain, and departing from it at the moment of death. He shares this discovery with Sarkar, who immediately accepts*

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what Peter has been having difficulty believing: that the electrical field was in fact Peggy's soul. Peter has found the first scientific proof for some form of continuing existence after death.

Peter manages to get additional recordings of the soulwave*—the name he adopts for the coherent electrical field—in the brains of over a hundred healthy people. He also gets two additional recordings of the soulwave leaving dying bodies. Sarkar pushes Peter to pursue the one question that Peter had been avoiding: when does the soulwave first appear in humans? Twelve years ago, Peter and Cathy had made what was, for them, a very difficult decision: to have an abortion. Peter does abdominal scans of thirty-two pregnant women, and finds that the soulwave first appears nine or ten weeks after conception, just about the time Cathy had terminated her pregnancy. Peter realizes that once he goes public with his findings, he will be damned by people on both sides of the abortion issue.*

Peter holds a press conference to announce the discovery of the soulwave, and does a media tour that includes appearances on Donahue *and* Geraldo. *Everyone wants to know the answer to one question: what is life after death really like? Peter says he has no idea—there's nothing in his data to give any indication.*

Sarkar proposes an experiment to answer that question: he suggests using his neural-scanning techniques to duplicate a human brain inside a computer, then excise all the neural-net connections related to biological functioning. What's left might be, in some way, an approximation of whatever part of the human psyche might survive separate from the body after death.

Peter is intrigued, but wants to go a step further, indulging his curiosity about nanotech immortality by making a second computer simulacrum that has all concerns about aging and death edited out—a simulation of a human mind that knows it is immortal.

A scan of Peter's own brain is used as the source for creating three computer simulations: the "Spirit" sim, which attempts to model life after death; the "Ambrotos" sim, which models immortality; and "Control," an unmodified version to serve as a baseline for the experiment. The three sims are activated inside the computers at Sarkar's company. Peter and Sarkar have dialogs with the two modified sims about the nature of life after death and immortality, and Peter adopts the Control sim as a private confidant with which to share his marital woes.

Meanwhile, Peter also becomes intrigued by Sarkar's artificial-life experiments, which use the principles of cumulative evolution *to create very complex computer simulations out of simple mathematical formulae—simulations so complex that they are arguably alive.*

Left running unattended, the three sims together access the online help system of Sarkar's computers and find their way out into the global computer network. Two of the sims are content to pursue the boundless information and virtual-reality simula-

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tions available on the net—but the third has a much more concrete agenda. It uses electronic funds transfer to arrange for a hit man to castrate and then kill Hans Larsen.

Detective Sandra Philo is assigned to the Larsen murder. She realizes it is likely a professional hit . . . and begins the search for who might have ordered it.

Sandra's investigation uncovers that Hans Larsen had been sleeping with his co-worker Cathy Hobson—making her, and her husband, Peter Hobson, likely suspects in the murder investigation.

The same sim that arranged the death of Hans Larsen now turns its attention to Cathy's father, Rod Churchill, whose coldness had left Cathy vulnerable to Larsen's advances. After breaking into a government medical-records database, the sim discovers that Rod is taking the prescription drug phenelzine. The sim tampers with the central ordering computer at a fast-food delivery chain that Rod uses every Wednesday night. The next time he orders his standard meal, his blood pressure shoots sky-high while eating it, and he drops dead, apparently from an aneurysm.

Meanwhile, Spirit, the life-after-death sim, has discovered Sarkar's artificial-life experiments, and has started modifying them. To Sarkar's and Peter's astonishment, Spirit has turned out to be much more intelligent than the flesh-and-blood Peter Hobson: in eliminating all neural-net connections related to the physical body, Sarkar has apparently also eliminated the limitations that cause neural nets—and the ideas they are carrying—to rapidly decay in the brain. This allows Spirit to build up very complex thoughts.

The death of Rod Churchill is initially taken as accidental, but in doing a database search Sandra Philo discovers the surprising coincidence that Cathy Hobson has had two deaths associated with her recently—first Hans Larsen, and now her father.

Sandra visits the Churchill home and finds the computerized printout of Rod's fast-food order and his prescription bottle of phenelzine, which has a sticker on it warning of severe dietary restrictions. Her curiosity piqued, she visits Rod's doctor and discovers that phenelzine is an antidepressant drug. Rod's previous doctor had died recently, and his new doctor had recognized at once what the old doctor had failed to diagnose, namely that Rod had suffered from lifelong clinical depression. Phenelzine, despite the dietary restrictions that went with its use, was the only treatment for this that Rod had responded to. But in looking over the fast food order, the doctor says there's no way Rod, who understood well his dietary restrictions, would have ordered regular gravy as part of his meal, since most gravies contain tyramine, which would react with the phenelzine to raise Rod's blood pressure to crisis levels.

Sandra visits the fast-food ordering facility and finds that Rod's order had been altered from its usual standard, with regular gravy substituted for the

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synthetic tyramine-free gravy he normally had. Rod's death now looks like a clever murder—and Cathy Hobson, with her degree in chemistry, looks like a very likely suspect, especially after Sandra discovers that the government medical database records for Rod Churchill had been accessed using an account that had belonged to a doctor who had gone to university with Cathy and Peter Hobson.

Sandra confronts Cathy, who denies any involvement in either murder, but Cathy now wonders if her husband Peter is responsible. She asks Peter if he arranged the murders; Peter is shocked at the suggestion . . . but then thinks of the sims. Perhaps one of them is guilty; in cutting neural-network connections, Sarkar might have inadvertently removed whatever it is that causes human morality. Peter calls Sarkar at home, and the two of them race to the offices of Mirror Image, Sarkar's company, in hopes of pulling the plug before whichever sim is responsible kills again.

Part 4.

CHAPTER 37

Sarkar cracked his knuckles nervously, shifted his barstool in front of the master computer console, and spoke into the microphone: "Login."

"Login name?" asked the computer.

"Sarkar."

"Hello, Sarkar. Command?"

"Multiple delete, no prompts: all files in subdirectories Control, Spirit, and Ambrotos."

"Confirm delete?"

"Yes."

"Delete failure. Files are read-only."

Sarkar nodded. "Attributes, all files and subdirectories specified previously, read-only off."

"Attributes are password locked."

"Password: Abu Yusuf."

"Incorrect password."

Sarkar turned to Peter. "That's the only password I use these days."

Peter shrugged. "Try again."

"Password: Abu Yusuf." He spelled it.

"Incorrect password."

"Who locked the files?" asked Sarkar.

"Hobson, Peter G.," replied the computer.

Peter's heart began to pound. "Oh, shit."

"Display user log, Hobson, Peter G.," said Sarkar.

A list of dates and times appeared on the screen. Sarkar slapped his hand against the table top. "See that? Node 999? Diagnostic mode. Your account was used, but accessed internally —from inside the system."

"Damn!" Peter leaned into the mike. "Login."

"Login name?" said the computer.

"Fobson."

"Hello, Peter. Should I terminate your other session?"

"What other session?"

"You are logged on here at node 001 and also at node 999."

Sarkar leaned forward. "Yes," said Peter. "Absolutely. Terminate session at node 999."

"Logoff failure."

"Damn," said Peter. He turned to Sarkar. "Can that other session over-

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ride this one?"

"No. The most-recent login takes precedence."

"OK," said Peter, rubbing his hands together. "Reference directories and files previously specified by Sarkar. Unlock attributes."

"Password?"

"Password: Mugato."

"Incorrect password."

"Password: Sybok."

"Incorrect password."

"Dammit," said Peter. He looked to Sarkar. "Those are the only two passwords I ever use."

Sarkar exhaled noisily. "They're not going to let us erase them."

"Can we take this system offline?"

Sarkar nodded and spoke into the microphone. "Initiate shutdown."

"Jobs are currently running. Confirm command?"

"Yes. Initiate shutdown."

"Password?"

"Password: Abu—"

The red light on the microphone winked off. Sarkar slammed his palm against the console again. "They've shut off voice input."

"Christ," said Peter.

"This is silly," said Sarkar, angrily. "We can still pull the physical plug." He reached for the phone, dialed a three-digit extension.

"Maintenance," said a woman's voice on the other end of the line.

"Hello," said Sarkar. "I know it is late, but this is Dr. Muhammed speaking. We are, ah, having a little difficulty up here. I need you to cut all power to our computing facility."

"Cut it, sir?"

"That's correct."

"OK," she said. "It'll take a few minutes. You're aware, though, that your data-processing department is on a UPS—you know, an uninterruptable power supply. It'll run on batteries for a while."

"How long?"

"If everything's turned on, only six or seven minutes—just enough to weather any short blackout."

"Can you disconnect the UPS?"

"Sure, if you like. It'll have to be physically unplugged; I can't turn it off from down here. I'm the only one on duty right now. Can I get someone to do it for you tomorrow?"

"This is an emergency," said Sarkar. "Can you come up and show us how to do it? I've someone here with me if it's warm bodies you need."

"OK. You want me to cut the mains before I come up?"

"No—we'll cut them after the UPS is disconnected." He covered the mouthpiece and spoke to Peter. "That means everything will go off at once, without giving the sims any warning."

Peter nodded.

"Whatever you say, sir," said the maintenance person. "Give me a few minutes, then I'll be up." Sarkar put down the phone.

"What will you do once the power is off?" asked Peter.

Sarkar was already on the floor, trying to remove an access panel from underneath the computer console. "Take out the optical drives and hook them up to a test bench. I can zap data on a bit-by-bit basis, if need be, using a Norton laser, so—"

The phone rang.

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"Can you get that?" Sarkar said, struggling with a stubborn wing-nut.

The video phone's screen displayed a notice that the incoming call was audio-only. Peter picked up the handset. "Hello?"

There was staticky silence for about two seconds, then an obviously synthesized voice came on. "Hel-lo," it said.

Peter felt himself flush with anger. He hated computerized telephone solicitations. He was in the process of slamming down the receiver when he heard the next word, "Pe-ter."

In the split second before the handset hit the cradle, he realized that even if the soliciting computer was working from an online phone directory, there's no way a stranger would expect to find him at this number. He stopped short and pulled the receiver back to his face.

"Who is this?" he said. He glanced down at the lights on the phone deskset. This wasn't a call being transferred internally; it was coming over an outside line.

"It's," said the voice, dull and mechanical, "you."

Peter held the handset in front of his face, looking at it as if it were a serpent.

More words came from the earpiece, each one separated from the next by a small, static-filled space. "Surely you didn't expect us to stay cooped up on that small workstation?"

The maintenance person arrived a few minutes later, carrying a toolbox. Sarkar looked up at her, turmoil plain, at least to Peter's eyes, on Sarkar's face.

"All set?" she said.

"Ah, no," said Sarkar. "Sorry to have dragged you up here. We, ah, don't need to disconnect the UPS anymore, or to cut the mains."

The woman looked surprised. "Whatever you say."

"My apologies," said Sarkar.

She nodded and left.

Peter and Sarkar sat staring at each other, dumbfounded.

"We really fucked up, didn't we?" said Peter at last.

Sarkar nodded.

"Damn," said Peter. "God damn it." A long pause. "There's no way to shut them off now that they're out in the net, is there?"

Sarkar shook his head.

"Now what?" said Peter.

"I don't know," said Sarkar. "I don't know."

"If we knew which sim was responsible, maybe we could find a way to isolate that particular one. But, damn, how do we figure that out?"

"Morality," said Sarkar.

"What?"

"Do you know Lawrence Kohlberg?"

Peter shook his head.

"He was a psychologist who did research on moral reasoning back in the 1960s. I studied him while preparing an expert system for the Clarke Institute of Psychiatry."

"So?"

"So this whole mess is a question of morality—why one version of you would behave differently from the others. Surely the key to which sim is

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guilty is tied into the nature of human morality."

Peter wasn't really listening. "Is there anything else we can do to erase the sims?"

"Not now that they're out in the net. Look, you're probably right: it will be useful to identify which sim is guilty. Let me ask you a question."

"What?"

Sarkar paused, remembering. "Say a man's wife is terminally ill, but she could be saved by a drug that cost $20,000."

"What's this got to do with anything?"

"Just listen—it's one of Kohlberg's test scenarios. Suppose that the man had only been able to come up with $10,000, but the pharmacist refused to let him have the drug, even though he promised to pay the rest of the cost later. The man then steals the drug to save his wife's life. Is the man's act morally right or wrong?"

Peter frowned. "It's right, of course."

"But *why?* That's the key."

"I—I don't know. It just is."

Sarkar nodded. "I suspect each sim would give a different reason. Kohlberg defined six levels of moral reasoning. At the lowest, one believes moral behavior is simply that which avoids punishment. At the highest, which Kohlberg considered the province of moral giants like Gandhi and Martin Luther King, moral behavior is based on abstract ethical principles. At that stage, external laws against theft are irrelevant; your own internalized moral code would dictate that you must value another's life more greatly than any repercussions you might suffer yourself because of the crime."

"Well, that's what I believe."

"Mahatma Hobson," said Sarkar. "Presumably the control sim would share that same point of view. But Kohlberg found that criminals were likely to be at a lower stage of moral reasoning than non-criminals of the same age who had the same IQ. Ambrotos might be fixated at the lowest level, level one—the avoidance of punishment."

"Why?"

"An immortal will live forever, but he can also spend forever in jail. A life sentence would be a terrifying thought to him."

"But how often does a true life sentence get handed down? You know the old saying, 'Don't do the crime if you can't do the time.' Well, Ambrotos might very well think he could do *any* crime because, after all, he *can* do the time."

"Good point," said Sarkar. "But I still think he's the guilty one. They say time heals all wounds, but perhaps if you knew you were going to live forever, you'd want to deal with anything that was going to fester in your mind for century after century."

Peter shook his head. "I don't think so. Look—if murder is a terrible crime to me, wouldn't it be unthinkable—the ultimate atrocity—to an immortal version of me, who knew life could go on forever?"

Sarkar sighed. "Perhaps. I guess it could go either way. But what about Spirit? His moral reasoning, too, could be fixated at a low level. Even though Spirit is dead, we have simu-

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lated neither heaven nor hell for him. So perhaps he considers himself to be in Purgatory. If he behaves well, maybe he believes he will be allowed entrance to heaven. Kohlberg's second stage defines moral acts as those which gain rewards."

Peter shook his head again. "I don't really believe in heaven or hell."

Sarkar tried another tack. "Well, then, consider this: murder is a crime of passion, and passion is a failing of flesh and blood. Remove sex from the human psyche and you would have no reason to kill a philanderer. That would argue for Spirit's innocence, and, by process of elimination, for Ambroto's guilt."

"Maybe," said Peter. "On the other hand, Spirit *knows* there is life after death—knows it by virtue of his existence. So, to him, murder would be a *less* heinous crime than it would be for Ambrotos, since it's not a complete ending for the victim. Spirit would thus be much more likely to feel uncomfortable committing murders."

Sarkar sighed, frustrated. "So you could argue that one either way, too." He glanced at his watch. "Look—there's nothing more we can do here." He paused. "In fact there may be nothing more we can do *anywhere.*" He sat quietly for a moment, thinking. "Go home. Tomorrow is Saturday; I'll come by your place around ten in the morning and we can try to figure out what to do next."

Peter nodded wearily.

"But first—" Sarkar pulled out his wallet, fished out a pair of fifties, and handed them to Peter.

"What's this?"

"The hundred dollars I borrowed from you last week. I want to be sure the sims have no cause to resent me. Before we go, send a message into the net telling them that I paid you back."

Net News Digest

A group of protestors announced late yesterday that Florida's SeaWorld, the last U.S. entertainment institution to still keep dolphins in captivity, was refusing their requests to try to determine if dolphins also exhibited the soulwave.

George Hendricks, 27, a born-again Christian, today filed suit in Dayton, Ohio, charging that his parents, Daniel and Kim Hendricks, both 53, in failing to have baptized George's brother Paul, who died last year in an automobile accident at age 24, were guilty of neglect and abuse by preventing Paul's soul from being able to enter heaven.

Further research from The Hague, Netherlands, indicates that departing soulwaves seem to be moving in a very specific direction. "At first we thought each wave was going separately, but that's before we took into account the time of day of each individual's death," said bioethics professor Maarten Lely. "It now seems that all soulwaves are traveling in the same direction. For want of a better reference, that direction is approximately toward the constellation of Orion."

* * *

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Germany became the first country today to make it explicitly illegal to interfere in any way with the departure of soulwaves from dying bodies. France, Great Britain, Japan, and Mexico are currently debating similar legislation.

The suicide rates on Native American reserves in the United States and Canada, and in the three largest ghettos in the U.S., were at a five-year high this past month. One suicide note, from Los Angeles, typified a recurrent theme: "Something beyond this life exists. It can't be worse than being here."

CHAPTER 38

Cathy was lying on her back in bed, staring at the ceiling, when Peter entered. He could see by the Hobson Monitor that she was wide awake, so he didn't make any effort to be quiet.

"Peter?" said Cathy.

"Hmm?"

"What went on this evening?"

"I had to see Sarkar."

Cathy's voice was tightly controlled. "Do you know who killed my father? Who killed Hans?"

Peter started to say something then fell silent.

"Trust," she said, rolling slightly toward him, "has to be a two-way street." She waited a moment. "Do you know who killed them?"

"No," said Peter again, removing his socks. And then, a moment later, "not for sure."

"But you have your suspicions?"

Peter didn't trust his voice. He nodded in the darkness.

"Who?"

"It's only a guess," he said. "Besides, we're not even sure that your father was murdered."

Firmly: "Who?"

He let out a long sigh. "This is going to take some explaining." He had his shirt off now. "Sarkar and I have been doing some . . . research into artificial intelligence."

Her face, blue-gray in the dim room, was impassive.

"Sarkar created three duplicates of my mind inside a computer."

Cathy's voice was tinged with mild surprise. "You mean expert systems?"

"More than that. Much more. He's copied every neuron, every neural net. They are, for all intents and purposes, complete duplicates of my personality."

"I didn't know that sort of thing was possible."

"It's still experimental, but, yes, it's possible. Sarkar invented the technique."

"God. And you think one of these—these duplicates was responsible for the murders?"

Peter's voice was faint. "Maybe."

Cathy's eyes were wide with horror. "But—but why would duplicates of your mind do something you yourself would not?"

Peter had finished changing into his pajamas. "Because two of the simulations are not duplicates. Parts of what I am have been removed from them. It's possible that we accidentally deleted whatever was responsible for human morality." He sat on the edge of the bed. "I tell you, I would never kill anyone. Not even Hans. But part of me very much

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wanted him dead."

Cathy's voice was bitter. "And my father? Did part of you want him dead, too?"

Peter shrugged.

"Well?"

"I, ah, have never really liked your father. But no, until recently, I had no reason to hate him. But... but then you told me about your counseling session. He hurt you when you were young. He shook your confidence."

"And one of the duplicates killed him for that?"

A shrug in the darkness.

"Turn the fucking things off," said Cathy.

"We can't," said Peter. "We tried. They've escaped out into the net."

"God," said Cathy, putting all her terror and fury into that single syllable.

They were silent for a time. She had moved away from him slightly in the bed. Peter looked at her, trying to decipher the mixture of emotions on her face. At last, her voice trembling slightly, she said, "Is there anyone else you want dead?"

"Sarkar asked me the same thing," he said, annoyed, "but I can't think of anyone."

"What about—what about me?" said Cathy.

"You? Of course not."

"But I hurt you."

"Yes. But I don't want you dead."

Peter's words didn't seem to calm her. "Christ, Peter, how could you do something so stupid?"

"I—I don't know. We didn't mean to."

"What about the detective?"

"What about her?"

"What will happen when she gets too close to the truth?" asked Cathy. "Will you want her dead, too?"

Sarkar arrived at Peter and Cathy's house at 10:15 the next morning. They sat there, the three of them, chewing on bagels that were past their prime.

"So what do we do now?" said Cathy, arms folded across her chest.

"Go to the police," said Sarkar.

Peter was shocked. "What?"

"The police," said Sarkar again. "This is completely out of control. We need their help."

"But—"

"Call the police. Tell them the truth. This is a new phenomenon. We didn't expect this result. Tell them that."

"If you do that," said Cathy slowly, "there will be repercussions."

"Indeed," said Peter. "Charges would be laid."

"What charges?" said Sarkar. "We've done nothing wrong."

"Are you kidding?" said Peter. "They could charge me with manslaughter, maybe. Or as an accessory to murder. And they could charge you with criminal negligence."

Sarkar's eyes went wide. "Crim—"

"Not to mention getting you under hacker laws," said Cathy. "If I understand all this correctly, you've created a piece of software that's out there violating other people's computer systems and stealing resources. That's a felony."

"But we intended nothing wrong," said Sarkar.

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"The crown attorney could run circles around us," said Peter. "A man and his best friend create software that kills people the man hated. Easy enough to discredit any claim I didn't have that in mind all along. And remember that case against Consolidated Edison? Frankenstein statutes. Those who seek to profit from technology must bear the costs of unforeseen consequences."

"Those are American laws," said Sarkar.

"I suspect a Canadian court would adopt a similar principle," said Cathy.

"Regardless," said Sarkar, "the sims have to be stopped."

"Yes," said Cathy.

Sarkar looked at Peter. "Pick up the phone. Dial 9-1-1."

"But what could the police do?" asked Peter, spreading his arms. "I'd be in favor of telling them, perhaps, if there was something they could do."

"They could order a shutdown of the net," said Sarkar.

"Are you kidding? Only CSIS or the RCMP could do that—and I bet they'd need to invoke the War Measures Act to suspend access to information on that large a scale. Meanwhile, what if the sims have moved down into the States? Or across the Atlantic?" Peter shook his head. "There's no way we'd ever get the net scoured clean."

Sarkar nodded slowly. "Perhaps you're right."

They were silent for a time. Finally, Cathy said, "Isn't there some way you can clean them off the net yourself?"

They looked at her expectantly.

"You know," she said, "write a virus that would track them down and destroy them. I remember the Internet worm, from back when I was in university—it was all over the world in a matter of days."

Sarkar looked excited. "Maybe," he said. "Maybe."

Peter looked at him. He tried to keep his voice calm. "The sims are huge, after all. They can't be that hard to find."

Sarkar was nodding. "A virus that checked all files bigger than, say, ten gigabytes . . . . It could look for two or three basic patterns from your neural nets. If it found them, it would erase the file. Yes—yes, I think I could write something like that." He turned to Cathy. "Brilliant, Catherine!"

"How long would it take to write?" asked Peter.

"I am not sure," replied Sarkar. "I've never written a virus before. Couple of days."

Peter nodded. "Let's pray that this works."

Sarkar looked at him. "*I* face Mecca five times a day and pray. Perhaps we would have better luck if both of you really did pray, too." He rose to his feet. "I better get going. I've got a lot of work to do."

CHAPTER 39

Peter had been trying to prepare himself for the inevitable encounter. Still, every time his intercom buzzed, he felt his heart begin to race. The first few times were false alarms. Then—

"Peter," said his secretary's voice, "there's an Inspector Philo here to see you, from the Metro Police."

Peter took a very deep breath, held

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it for a few seconds, then let it out in a long, whispery sigh. He touched a button on his intercom. "Send her in, please."

A moment later the door to his office opened and in walked Alexandria Philo. Peter had expected her to be in a police uniform. Instead, she was wearing a trim, professional gray blazer, matching slacks, and a coffee-colored silk blouse. She had on two tiny green earrings. Her short hair was bright red, her eyes bright green. And she was tall. She was carrying a black attaché case.

"Hello, Detective," Peter said, rising to his feet and extending his hand.

"Hello," Sandra said, giving his hand a firm shake. "I take it you were expecting me?"

"Um, why do you say that?"

"I couldn't help overhear you talking to your secretary. You said, 'send her in.' But she hadn't told you my first name, or given you any other indication that I was a woman."

Peter smiled. "You're very good at your job. My wife had said a few things about you."

"I see." Sandra was quiet, staring expectantly at Peter.

Peter laughed. "On the other hand, I'm very good at my job, too. And a large part of it involves attending meetings with government officials, all of whom have taken courses in interpersonal communication. It's going to take more than just a protracted silence to get me to spill my guts."

Sandra laughed. She hadn't looked pretty to Peter when she came in, but when she laughed she looked very nice indeed.

"Please have a seat, Ms. Philo."

She smiled and took a chair, smoothing out her pants as she sat as if she often wore skirts. Cathy had the same habit.

There was a short silence. "Would you like coffee?" asked Peter. "Tea?"

"Coffee, please. Double double." She looked uncomfortable. "This is a part of my job that I don't like, Dr. Hobson."

Peter got up and crossed over to the coffee maker. "Please—call me Peter."

"Peter." She smiled. "I don't like the way involved parties get treated in a case such as this. We police often bully people with little regard for good manners or the principle of assumed innocence."

Peter handed her a cup of coffee.

"So, Doctor—" She stopped herself and smiled. "So, Peter, I'm going to have to ask you some questions, and I hope you'll understand that I'm just doing my job."

"Of course."

"As you know, one of your wife's coworkers was murdered."

Peter nodded. "Yes. It came as quite a shock."

Sandra looked at him with her head tilted to one side.

"I'm sorry," said Peter, confused. "Did I say something wrong?"

"Oh, it's nothing. Just that there was evidence that a stunner was used to subdue the victim. Your 'quite a shock' comment struck me as funny." She raised a hand. "Forgive me; you develop a fairly thick skin in this line of work." A pause. "Have you ever

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used a stunner?"

"No."

"Do you own one?"

"They're illegal in Ontario, except for police work."

Sandra smiled. "But you can buy them easily in New York or Quebec."

"No," said Peter, "I've never used one."

"I'm sorry to have to ask," said Sandra.

"That darned police training," said Peter.

"Exactly." She smiled. "Did you know the deceased man?"

Peter tried to say the name nonchalantly. "Hans Larsen? Sure, I'd met him—I've met most of Cathy's coworkers, either at informal gatherings or at her company's Christmas parties."

"What did you think of him?"

"Of Larsen?" Peter took a sip of coffee. "I thought he was a jerk."

Sandra nodded. "A number of people seemed to have shared your opinion, although others spoke highly of him."

"I suspect that's the way it is for just about everyone," said Peter.

"Just about." Silence again, then: "Look, Peter, you seem like a nice guy. I don't want to bring up painful memories. But I know your wife and Hans, well . . . ."

Peter nodded. "Yes, they did. But that was over a long time ago."

Sandra smiled. "True. But it was more recently that your wife told you about it."

"And now Larsen is dead."

Sandra nodded once. "And now Larsen is dead."

"Ms. Philo—"

She raised a hand. "You can call me Sandra."

Peter smiled. "Sandra." *Play it cool,* he thought. Sarkar would have the virus ready today or tomorrow. It'll all be over soon. "Let me tell you something, Sandra. I'm a peaceful person. I don't like wrestling or boxing. I haven't hit anyone since I was a boy. I'd never hit my wife. And if I had a child, I'd never spank him or her." He took a sip of coffee. Had he said enough? Would more be better? Cool, dammit. Be cool. But all he wanted to do was tell her the truth about himself—not those machine duplicates, but the real him, the flesh-and-blood him.

"I—I think a lot of the problems in this world come from violence. By spanking our kids we teach them that there are times when it's OK to hit someone you love—and then we're shocked to discover that these same kids grow up thinking it's OK to hit their spouses. I don't even kill houseflies, Sandra; I capture them in drinking glasses and take them outside. You're asking whether I killed Larsen. And I'll tell you directly that I might indeed have been angry with him, I might indeed have hated him, but killing or physically hurting isn't in my nature. It's something I simply would not do."

"Or even think about?" asked Sandra.

Peter spread his arms. "Well, we all think about things. But there's a world of difference between an idle fantasy and reality." If there weren't, thought Peter, I'd have had you and

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my secretary and a hundred other women right on this very desktop.

Sandra rearranged herself slightly in her chair. "I don't normally talk about my personal life while on the job, but I went through something very similar to what you did, Peter. My husband—my ex-husband, as of a few months ago—cheated as well. I'm not a violent person, either. I know some would consider that an unlikely thing for a police officer to say, but it's true. But when I found out what Walter had done—well, I wanted him dead, and I wanted *her* dead. I'm not given to throwing things, but when I found out I threw the remote control for our TV across the room. It smashed into the wall, and the case broke open; you can still see the spot on the wall where it hit. So I know, Peter, I *know* that people have violent reactions when this sort of thing happens."

Peter nodded slowly. "But I did not kill Hans Larsen."

"We believe it was a professional murder."

"I didn't arrange for his killing, either."

"Let me tell you exactly what my problem is here," said Sandra. "As I said, we're looking at a professional hit. Frankly, that sort of thing costs a lot of money—especially with the, ah, extra work this one involved. You and Cathy are better off than most of her coworkers; if anyone could have afforded this sort of thing, it would have been you or her."

"But we didn't do it," said Peter. "Look, I'd be glad to take a lie-detector test."

Sandra smiled sweetly. "How thoughtful of you to volunteer. I have portable equipment with me."

Peter felt his stomach muscles tighten. "Really?"

"Oh, yes. In fact, it's a Veriscan Plus—that's made by your company, isn't it?"

His eyes narrowed. "Yes."

"So I'm sure you have a lot of faith in its abilities. Would you really be willing to take such a test?"

He hesitated. "With my legal counsel present, of course."

"Legal counsel?" Sandra smiled again. "You haven't been charged with anything."

Peter considered. "All right," he said. "If it will put an end to all this, yes, I'll agree to a test, here and now. But in the absence of counsel, you may ask three questions only—did I kill Hans Larsen? Did I kill Rod Churchill? Did I arrange their deaths?"

"I have to ask more than three questions—calibrating the machine requires it; you know that."

"All right," said Peter. "Presumably you have a script of calibration questions. I'll agree to the test so long as you don't deviate from that script."

"Very well." Sandra opened her attaché case, revealing the polygraph equipment within.

Peter peered at the device. "Don't you have to be a specialist to operate those machines?"

"You should read your own product brochures, Peter. There's an expert-system AI chip inside. Anyone can operate one these days."

Peter grunted. Sandra affixed small

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sensors to Peter's forearm and wrist. A flat-panel screen popped up from the attaché case, and Sandra angled it so that only she could see it. She touched a few controls, then began to ask questions. "What's your name?"

"Peter Hobson."

"How old are you?"

"Forty-two."

"Where were you born?"

"North Battleford, Saskatchewan."

"Now lie to me. Tell me again where you were born."

"Scotland."

"Tell the truth: What is your wife's first name?"

"Catherine."

"Now lie: what is your wife's middle name?"

"Ah—T'Pring."

"Did you kill Hans Larsen?"

Peter watched Sandra carefully. "No."

"Did you kill Rod Churchill?"

"No."

"Did you arrange the killing of either of them?"

"No."

"Do you have any idea who killed them?"

Peter held up a hand. "We agreed only three questions, Inspector."

"I'm sorry. Surely you don't mind answering one more, though?" She smiled. "I no more like having to be suspicious of you than you like being a suspect. It would be nice to be able to scratch you off my list."

Peter thought. Dammit. "All right," he said slowly. "I don't know any person who might have killed them."

Sandra looked up. "I'm sorry—I guess I upset you when I went beyond what we'd agreed. There was some very strange activity when you said 'person.' Would you please bear with me for just one moment more and repeat your last answer?"

Peter yanked the sensor from his arm, and threw it on the desktop. "I've already put up with more than we agreed," he said, an edge in his voice. He knew he was making matters worse, and he fought to keep panic from overwhelming him. He pulled the second sensor off his wrist. "I'm through answering questions."

"I'm sorry," said Sandra. "Forgive me."

Peter made an effort to calm himself. "That's all right," he said. "I hope you got what you were looking for."

"Oh, yes," said Sandra, closing her case. "Yes, indeed."

It didn't take long for Spirit's artificial lifeforms to develop multicellularism: chains of distinct units, attached together into simple rows. Eventually, the lifeforms stumbled onto the trick of doubling up into two rows: twice as many cells, but each one still exposed on at least one side to the nutrient soup of Spirit's simulated sea. And then the long rows of cells began to double back on themselves, forming U shapes. And, eventually, the U shapes closed over on the bottom, forming bags. Then, at last, the great breakthrough: the bottom and top of the bag opened up, resulting in a cylinder made of a double layer of cells, open at both ends: the basic body plan of all animal life on Earth, with an eating orifice at the front end an excretory one at the

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rear.

Generations were born. Generations died.

And Spirit kept selecting.

CHAPTER 40

It had taken some work, but a while ago Sandra Philo had gotten the monitoring warrant she'd requested, allowing her to place a transponder inside the rear bumper of Peter Hobson's car. She'd been given a two-week permit by the judge. The transponder had a timing chip in it: it had operated for precisely the period authorized, and not a second longer. The two weeks were now up, and Sandra was analyzing the collected data.

Peter drove to his office a lot, and also went frequently to several restaurants, including Sonny Gotlieb's, a place Sandra quite liked herself; to North York General Hospital (he was on their board of directors); and elsewhere. But there was one address that kept appearing over and over in the logs: 88 Connie Crescent in Concord. That was an industrial unit that housed four different businesses. She cross-referenced the address with Peter's telephone records, obtained under the same warrant. He'd repeatedly called a number registered to Mirror Image, 88 Connie Crescent.

Sandra called up InfoGlobe and got screens full of data about that company: Mirror Image Ltd., founded in 2001 by wunderkind Sarkar Muhammed, a firm specializing in expert systems and artificial-intelligence applications. Big contracts with the Ontario government and several *Financial Post 100* corporations.

Sandra thought back to the lie-detector test Peter Hobson had taken. "I don't know any person who might have killed them," he'd said—and his vital signs had been agitated when he said the word "person."

And now he was spending time at an artificial-intelligence lab.

It was almost too wild, too crazy.

And yet Hobson himself hadn't committed the murders. The lie detector had shown that.

It was the kind of thing the law-enforcement journals had been warning was coming down the pike.

Perhaps, now, at last, it was here.

Here.

Sandra leaned back in her chair, trying to absorb it all.

It certainly wasn't enough to get an arrest warrant.

Not an *arrest* warrant, no. But maybe a search warrant....

She saved her research files, logged off, and headed out the door.

It took five vehicles to get them all there: two patrol cars with a pair of uniformed officers apiece; a York Region squad car with the liaison officer from that police force—the raid would be conducted on York's turf; Sandra Philo's unmarked car, carrying herself and Jorgenson, head of the computer-crimes division; and the blue CCD van, carrying five analysts and their equipment.

The convoy pulled up outside 88 Connie Crescent at 10:17 A.M. Sandra and the four uniformed officers went directly inside; Jorgenson went over to the CCD van to confer with his

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team.

The receptionist at Mirror Image—an elderly Asian man—looked up in shock as Sandra and the uniforms entered. "Can I help you?" he said.

"Please move away from your computer terminal," said Sandra. "We have a warrant to search these premises." She held up the document.

"I think I'd better call Dr. Muhammed," said the man.

"You do that," said Sandra. She snapped her fingers, indicating that one of the uniforms should stay here, preventing the receptionist from using his terminal. Sandra and the other three headed inside.

A thin dark-skinned man appeared at the far end of the corridor.

"May I help you?" he said, his voice full of concern.

"Are you Sarkar Muhammed?" asked Sandra, closing the distance between them.

"Yes."

"I'm Detective Inspector Philo, Metropolitan Toronto Police." She handed him the warrant. "We have reason to believe that computer-related crimes have been committed from this establishment. This warrant gives us authority to search not just your offices, but your computer systems as well."

At that moment, the door to the reception area burst open and Jorgenson and the five analysts came in. "Make sure none of the employees touch any computer equipment," Jorgenson said to the senior uniformed officer. The cops started fanning out into the building. One of the corridor walls was largely glass, overlooking a big data-processing facility. Jorgenson pointed to two of the analysts. "Davis, Kato—you're in there." The two analysts went to the door, but it had a separate FILE lock.

"Dr. Muhammed," said Sandra, "our warrant gives us the right to break any locks we deem necessary. If you prefer we not do that, please unlock that door."

"Look," said Sarkar, "we've done nothing wrong here."

"Open the door, please," Sandra said firmly.

"I want to review this warrant with my attorney."

"Fine," said Sandra. "Jones, kick it."

"No!" said Sarkar. "All right, all right." He moved to the side of the door and pressed his thumb against the blue scanner. The deadbolt popped aside and the door slid open. Davis and Kato went in, the former going straight for the master console, the latter starting an inventory of the DASD tape and optical-drive units.

Jorgenson turned to Sarkar. "You have an AI lab here. Where is it?"

"We've done nothing wrong," said Sarkar again.

One of the uniforms reappeared at the far end of the corridor. "It's down here, Karl!"

Jorgenson jogged down the hall, the three remaining members of his team following. Sandra walked in that direction, too, checking the signs on each door as she went.

The Asian receptionist had appeared at the other end of the corridor, looking worried. Sarkar shouted, "Call Kejavee, my attorney—tell him

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what's happening." He then hurried off to follow Jorgenson.

Sarkar had been working in the AI lab when the receptionist had called him. He'd left the door open. By the time he got back there, Jorgenson was looming over the main console, unplugging the keyboard. He motioned to one of his associates who handed him another keyboard with a glossy black housing and silver keys. A diagnostic unit: every keystroke typed, every response from the computer, every disk-access delay would be recorded.

"Hey!" shouted Sarkar. "These are delicate systems. Be careful."

Jorgenson ignored him. He sat on the barstool and pulled a vinyl folder out of his briefcase. It contained an assortment of diskettes, CDs, and PCMCIA cards. He selected a card that would fit the drive on the console, inserted it, then hit some keys on his keyboard.

The computer's monitor cleared, then filled with diagnostic information about the system.

"Top of the line," said Jorgenson, impressed. "Fully populated with 512 gigabytes of RAM, five parallel math co-processors, self-referential-bus architecture." He tapped the spacebar; another screen came up. "Latest firmware revision, too. Nice."

He exited his program and began listing directories at the system prompt.

"What are you looking for?" asked Sarkar.

"Anything," said Sandra, entering the room."Everything." Then, to Jorgenson: "Any problems?"

"Not so far. He was already logged in, so we didn't need to crack the password file."

Sarkar was edging away from the group toward a console on the other side of the room—a console with a microphone stalk sticking up from it.

"Login," said Sarkar in a low voice, then, without waiting for the prompt, "Login name Sarkar."

"Hello, Sarkar," said the computer. "Shall I terminate your other session?"

Sandra Philo had come up behind him, the rounded front of her stunner pressing into the small of his back. "Don't do that," she said simply. She reached over to the console and flicked off the switch marked "Voice Input."

At that point, Kawalski, the liaison officer from York, appeared at the entrance of the room. "They've got a barber's chair upstairs," he said generally to the group, then, looking at Sarkar, "You give haircuts here?"

Sarkar shook his head. "It's actually a dentist's chair."

Jorgenson spoke without looking up. "Scanning room, no doubt," he said. Then to Sarkar: "I enjoyed your paper in last month's *Journal of AI Studies*. I'll want to search that room next." He went back to typing commands on his black-and-silver keyboard.

Sarkar sounded exasperated. "If you would just tell me what you're looking for—"

"Damn," said Jorgenson. "There are several encrypted banks here."

Sandra looked at Sarkar. "What's the decryption key?"

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Sarkar, feeling perhaps that he had some measure of control at last, said, "I do not believe I'm obligated to tell you."

Jorgenson got up from the stool. Without a word, a second analyst sat down on it and began typing commands.

"Doesn't matter," said Jorgenson with a shrug. "Valentina was with the KGB, back when there was such a thing. There's not much she can't crack."

Valentina popped a new datacard into the card slot, and typed furiously with two fingers. After several minutes, she looked at Sarkar, her face full of disappointment. Sarkar brightened visibly—perhaps she wasn't as good as Jorgenson had said. But then Sarkar's heart fell. The disappointment on her face was simply that of someone who'd been hoping for a good challenge, and had failed to find it. "The Hunsacker algorithm?" she said in a heavily accented voice, shaking her head. "You could have done better than that." Valentina pressed a few more keys and the screen, which to this point had been filled with gibberish, was replaced with English source-code listings.

She got up, and Jorgenson went back to work. He cleared the screen, then replaced Valentina's datacard with another of his own. "Initiating search," he said. The screen filled with a multi-column list of two hundred or so terms in alphabetical order.

"There's massive storage online here," said Jorgenson, "under a variety of compression schemes. It'll take a while to hunt through it all." He got up. "I'm going up to look at that scanning room."

Peter had an evening board meeting at North York General today, and rather than waste the morning fighting the telephones at the office he decided to do some work from home. But he was having trouble concentrating. Sarkar had said he'd have the virus finished today, but Peter still felt he should be doing something himself. Around 10:30 he logged into Mirror Image, hoping to see if he could fathom how the sims had gotten outside.

After dialing in, he issued the WHO command to see whether Sarkar was also online—Peter wanted to send him an e-mail hello. He was indeed. Peter then issued WHAT to see what sort of activity Sarkar was doing; if it was a background task, he probably wasn't actually sitting at the terminal, and so the e-mail would be a waste of time.

WHAT reported the following:

Node:	002
User:	Sarkar Muhammed
Logged in at:	08:14:22
Task:	text search

Well, a text search could be either background or foreground. Peter had high-level supervisory privileges on Sarkar's systems. He called for an echoing of the task at node 002 on his own monitor. The screen filled with a list of search terms, and a constantly

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updated tally of hits. Some, such as Toronto, had hundreds of hits so far, but others . . . .

Christ, thought Peter. *Look at that . . . .*

Sarkar was searching for "Hobson" and "Pete*" and "Cath*" and . . . .

Peter tapped out an e-mail message: "Nosy, aren't we?" He was about to send it when he noticed the full search parameters in the status line: "Search all systems; within each system, search all online and offline storage and all working memory."

A search like that could take hours. Sarkar would never order something like that—he was too well-organized not to have at least *some* idea how to narrow the search.

Peter glanced at the other search terms.

Oh, shit.

"Larsen," "Hans," "adultery," "affair."

Shit. Shit. Shit. No way Sarkar would be doing a search like that. Someone else was inside the system.

Node 002 was the AI lab at Mirror Image. Peter swung his chair to face his phone and hit the speed-dialer key for there.

The phone rang in the AI lab. "May I get that?" asked Sarkar.

Sandra nodded. She was watching the screen intently. Lots of hits on the common words—"affair" had over four hundred so far—but none on Hobson or Larsen.

Sarkar moved across the room to the video phone and hit the ANSWER key.

The Bell Canada logo backflipped away. Peter saw Sarkar's face, looking worried.

"What's—" said Peter, but that's all he said. In the background, over Sarkar's shoulder, he saw a profile of Sandra Philo. Peter broke the connection at once.

Philo there, at Mirror Image.

A raid. A goddamned raid.

Peter looked at his screen, slaved to node 002. Still no hits on "Hobson."

He thought for a second, then began tapping keys. Peter spun off a second session under Sarkar's login name, using the password he'd heard Sarkar use before. He then accessed the diagnostic-tools subdirectory and called up a file listing. There were hundreds of programs, including one called TEXTREP. That sounded promising. He called up help on it.

Good. Exactly what he needed. Syntax: search-term, replacement-term, search parameters.

Peter typed "TEXTREP/Hobson/Roddenberry/AI7-AI10"—meaning change all occurrences of "Hobson" to "Roddenberry" on artificial-intelligence systems seven through ten.

The program set to work. It was a much smaller search—only one term—and a much narrower area to search—only four computers instead of the hundred or more that Philo was currently examining. With luck, it would make all the substitutions before it was too late . . . .

The console beeped, signaling its task was complete. Jorgenson was back, having found nothing of inter-

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est in the scanning room. He looked at the screen, then at Sandra. Thirteen hits for Hobson. Sandra pointed at the tally. "Display them in context," she said.

Two appearances of the word in an online dictionary entry for "Hobson's choice."

A user-ID file, equating "fobson" with Peter G. Hobson.

A computerized Rolodex with home and business addresses for Peter Hobson.

And nine more references, mostly within copyright notices, to Hobson Monitoring Ltd. as parts of various pieces of scanning software.

"Nada," said Jorgenson.

"He's got an account here," said Sandra, turning to Sarkar.

"Who does?" he said.

"Peter Hobson."

"Oh, yes. We use some programs made by his company."

"Nothing more?"

"Well, he's a friend of mine, too. That's why I have his home address in my Rolodex." Sarkar looked innocent. "What were you expecting to find?"

CHAPTER 41

Cathy Hobson was exhausted. It had been a long day at the office, slogging away at the Tourism Ontario account. She'd stopped at Miracle Food Mart on the way home, but the idiot in front of her had decided to unload all his change on the cashier. Some people, Cathy thought, should be forced to use debit cards.

When she finally arrived at home, she pressed her thumb against the FILE scanner, leaning on it as if it were the only thing keeping her from collapsing to the ground. The green LED atop the scanner winked at her, the deadbolt sprang back, and the heavy door slid aside. She entered her house. The door closed behind her and the lock snicked back into place.

"Lights," she said.

Nothing happened. She cleared her throat and tried again. "Lights."

Still nothing. She sighed, set down her shopping bags, and groped for the manual switch. She found it, but still the lights did not go on.

Cathy made her way up into the living room. She could see the glowing LEDs on the VCR, so it wasn't a power failure; the entryway bulb was probably just burned out. She said "lights" once more, but the three ceramic table lamps—lamps that Cathy herself had made—remained dark.

Cathy shook her head. Peter was constantly fiddling with the house controls, and it always took a while to get things working properly again.

She lowered herself to the couch, spreading her aching feet out in front of her. Such a long day. She closed her eyes, enjoying the darkness. After a moment, remembering her groceries, she hauled herself up and headed down to the entryway. She tried both the light switch and saying the word "lights" again. Still nothing. She was about to bend over and pick up the bags when she noticed the phone sitting on the little table in the hall. The large red light adjacent to its keypad was on. She moved closer. The visual display said "Line in use."

The phone hadn't rung.

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And Peter wouldn't be home for hours yet; he had a board meeting tonight at North York General.

Unless . . . "Peter, are you home?"

No reply. She picked up the handset and heard a high-pitched whine. A modem.

She looked at the visual display again. "Private caller"—an incoming call, but whoever was using the modem had requested suppression of Call Display.

Jesus Christ, she thought. A sim.

She slammed the handset down, then picked it up again, jiggling the hook switch rapidly, trying to make enough line noise to sever the connection.

It didn't do any good. Peter, of course, had the finest in error-correcting modems, and the sim apparently had equally good hardware.

She moved quickly to the front door and pressed the UNLOCK button next to it. Nothing happened. She grabbed the manual handle. The door refused to budge. She hit the "In Case of Fire" override. The door was still jammed. She slid open the hall closet—it, at least, had no locking mechanism—and looked at the door control panel. An LED was glowing like a drop of blood next to the phrase "thwarting break-in." Normally the doors would instantly unlock in case of fire, but the smoke detectors denied that there was a fire, and some other detector said someone was trying to break in from outside. Cathy left the closet and looked through the peephole in the front door. No one was there. Of course.

She was trying to remain calm. There were other doors, but the master panel showed them all to be in anti-break-in mode as well. She could try going through a window, but they were all locked, too, and the glass was, of course, the best modern safety glass money could buy.

The word she'd been fighting not to think finally pushed to the surface of her consciousness.

Trapped.

Trapped in her own home.

She thought about trying to trigger the smoke detectors, but, of course, neither she nor Peter smoked, so there was no lighters anywhere in the house. And Peter didn't like the smell of matches or candles, so there were none of those either. Still, she could set fire to some paper on the stove. That might set off the alarms, unlocking the doors.

She hurried to the kitchen, taking care not to trip in the darkness. The moment she entered, though, she knew she was in trouble. The digital clocks on both the microwave and the regular oven were off. The kitchen power had been cut. There was a rechargeable flashlight plugged into a wall outlet. She pulled it out of the socket. It was supposed to come on automatically when the power went off, but it was dead. Cathy realized that the power must have been off in the kitchen for many hours, and so the flashlight had depleted its charge. But—that whine. The refrigerator was still on. She opened its door and a light went on inside. She felt the rush of cold air on her face.

The sim knew exactly what it was doing: the VCR and the fridge were

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still on, but the stove and the outlet that recharged the flashlight were off. As was typical in a smart house, every outlet was on its own circuit and fuse.

She made her way into the dining room and held on to the back of a chair for support. She tried to remain calm—calm, dammit! She thought about getting a kitchen knife, but that was pointless—there was no physical intruder. The control box for the house systems was in the basement, and that's where the phone cables entered, too—power and telecommunication lines were being systematically buried in response to fears that unshielded overhead lines caused cancer.

Cathy inched toward the top of the stairs that led to the basement. She opened the door. It was pitch black down there; for their fifth anniversary, Peter and Cathy had treated themselves to a home-theater system, so the blinds on the basement windows had been replaced with Mylar-lined curtains on electric rails—and the curtains had been drawn. Cathy thought she knew the layout well enough to find the incoming phone line even in the dark. She stepped onto the top stair—

The overhead sprinklers came on. No alarm—nothing to summon neighbors or the fire department. But cold water started showering down from the ceiling. Cathy gasped and ran back up into the living room. The sprinklers shut off behind her and came on in there. She moved onto the stairs leading up to the bedrooms. The sprinklers cut off in the living room and went on in the stairwell.

Cathy realized that they were following her—the sim had presumably keyed into the motion-sensors that were part of the burglar-alarm system. Through the mist, she could see that the LEDs on the VCR were now off—presumably to avoid starting a fire by electrical shorting.

Exhausted and wet, with no way to escape, Cathy decided to head for the bathroom. If the sprinklers were destined to follow her, she might as well be in the room in which they could do the least damage. She got into the bathtub and unhooked the shower curtain, using it as a tent to shield herself from the cold water.

Three hours later, Peter came home. The front door unlocked normally for him. He found the living room carpet soaked, and could hear the sprinklers running upstairs. He hurried up to the bathroom and opened the door. The moment he did so, the sprinklers stopped.

Cathy pushed off the shower curtain. Water streamed from it as she rose to stand up in the tub. Her voice was full of tightly controlled fury. "Neither I nor any version of me would ever have done anything like this to you." She glared at him. "We're even."

Cathy, quite sensibly, refused to stay in the house. Peter drove her to her sister's apartment. She was still angry, but was slowly calming down, and she accepted his embrace as they parted. Peter then went directly to his own office and logged onto the net. He sent an e-mail message out into the world:

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Date: 15 Dec 2011, 23:11 EST
From: Peter G. Hobson
To: my brothers
Subject: RTC request
I need to talk to you all in real-time conference immediately. Please respond.

It didn't take long for them to reply.

"I'm here," said one of his ghosts.

" 'Evening, Pete," said another.

"What is it?" asked a third.

They all spoke through the same voice chip; unless they identified themselves, there was no easy way to tell which sim was speaking. And even knowing the nodes they were using wouldn't tell him which sim was which. It didn't matter.

"I know what's going on," said Peter. "I know one of you is killing people on my behalf. But tonight Cathy was threatened. I will not tolerate that. Cathy is not to be harmed. Not now, not ever. Understand?"

Silence.

"Understand?"

Still no reply.

Peter sighed, exasperated. "Look, I know that Sarkar and I can't remove you from the net, but if there's any repetition, we will go public with your existence. The press would go apeshit over a story of a murdering AI having taken up residence inside the net. Don't think they wouldn't do a cold restart to get rid of you."

A voice from the speaker: "I'm sure you're mistaken, Peter. None of us would have committed murders. But if you go public, people will believe your claim—you are, after all, the famous Peter Hobson now. And that means *you* will be blamed for the deaths."

"I don't care at this point," said Peter. "I'll do whatever it takes to protect Cathy, even if it means going to jail myself."

"But Cathy has hurt you," said the synthesized voice. "More than anyone in the entire world, Cathy has hurt you."

"Hurting me," said Peter, "is not a capital crime. I'm not kidding: threaten her again, harm her in any way, and I will see to it that you are *all* destroyed. I'll find a way to do that somehow."

"We could," said the electronic voice, very slowly, "get rid of you to prevent that from happening."

"That would be suicide, in a sense," said Peter. "Or fratricide. In any event, *I* know that's something I wouldn't do, and that means it's also something that *you* wouldn't do."

"You would not have killed Cathy's coworker," said the voice, "and yet you believe one of us has done that."

Peter leaned back in his chair. "No, but—but I *wanted* to. I'm ashamed to admit it, but I wanted to see him dead. But I would not kill myself—I wouldn't even think about killing myself—and so I know you wouldn't seriously think about doing it, either."

"But you're thinking about killing *us,*" said the voice.

"That's different," said Peter. "I'm the original. You know that. And I know in my heart of hearts that I don't believe that computer simulacra are as alive as a flesh-and-blood person is. And because I believe that,

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you believe that, too."

"Perhaps," said the voice.

"And now you're trying to kill Cathy," Peter said. "At least that must stop. Don't harm Cathy. Don't threaten Cathy. Don't do *anything* to Cathy."

"But she hurt you," said the synthesizer again.

"Yes," said Peter, exasperated. "She hurt me. But it would hurt me *more* if she were not around. It would destroy me if she were dead."

"Why?" said the voice.

"Because I love her, dammit. I love her more than life itself. I love her with every fiber of my being."

"Really?" said the voice.

Peter paused, catching his breath. He considered. Was it just his anger talking? Was he blurting out things he didn't mean? Or was it true—really true? "Yes," he said softly, understanding at last, "yes, I really love her that much. I love her more than words can say."

"It's about time you admitted that, Petey-boy, even if you had to be pushed into it. Go get Cathy—doubtless you took her to her sister's house; that's what I would have done. Go get her and take her home. Nothing more will happen to her."

CHAPTER 42

The next day, Peter made sure Cathy got safely on her way to work, but he stayed home. He'd disconnected the electronic door system and had called a locksmith to come and put in old-fashioned key-operated deadbolts. While the locksmith worked, Peter sat in his office and stared out into space, trying to make sense of it all.

He thought about Rod Churchill.

A cold fish. Undemonstrative.

But he had been taking phenelzine—an antidepressant.

Meaning, of course, that he had been diagnosed as having clinical depression. But in the two decades Peter had known Rod Churchill, he'd seen no change in his demeanor. So maybe . . . maybe he'd been depressed all that time. Maybe he'd been depressed even longer than that, depressed during Cathy's childhood, leading him to be the lousy father he had been.

Peter shook his head. Rod Churchill—not a bastard, not an asshole. Just sick—a chemical imbalance.

Surely that mitigated what he'd done, made him less culpable for the way in which he'd treated his daughters.

Hell, thought Peter, we're all chemical machines. Peter couldn't function without his morning coffee. There was no doubt that Cathy became more irritable just before her period. And Hans Larsen had let his hormones guide him through his life.

Which was the real Peter? The sluggish, irritable guy who pulled himself out of bed each morning? Or the focused, driven person who arrived at the office, the drug caffeine working its magic? Which was the real Cathy? The cheerful, bright, sexy woman she was most of the time, or the cranky, quarrelsome person she became for a few days each month? And which the real Larsen? The drunken, sex-

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crazed lout Peter had known, or the fellow who apparently had done his job well and been liked by most of his coworkers? What, he wondered idly, would the guy have been like if someone were to cut off his dick? Probably a completely different person.

What was left of a person if you removed stimulants and depressants, inhibitors and disinhibitors, testosterone and estrogen? And what about children who'd received too little oxygen during birth? What about Down's syndrome—people altered completely by having an extra twenty-first chromosome? What about those with autism? Or dementia? Manic-depressives? Schizophrenics? Those who suffer from multiple personalities? Those with brain damage? Those with Alzheimer's? Surely the individuals affected aren't at fault. Surely none of those things reflect the actual people—the souls in question.

And what about those twin studies the Control sim had mentioned? Nature, not nurture, guided our behavior. When we weren't dancing to a chemical tune, we were marching to the genetic drummer.

Yet Rod Churchill had been getting help.

If he'd really been killed in the way Detective Philo suggested, the sim would have known that Rod was taking phenelzine, would have looked it up in a database of drugs, would have understood what Rod was being treated for. Could the sim have failed to realize that although the treatment might be new, the condition could have been longstanding? Surely that would have been enough evidence to commute any death sentence the sim had been contemplating?

No—no version of him would have killed Rod Churchill, knowing of this chemical problem. Pity him, yes, but surely not kill him. In fact, this called into question all of Sandra Philo's case. The sims, after all, had admitted to neither of the murders, and all Philo's evidence pointing to Peter, and from there to the sims, was circumstantial.

Peter breathed a sigh of relief. He would have not killed Rod Churchill. Rod had simply done something stupid, failing to follow his doctor's orders. And Hans Larsen? Well, Peter had always contended that dozens of angry spouses might have wanted him dead—including, now that he thought about it, Larsen's own wife, who, Peter seemed to recall, worked in a bank and could have embezzled the funds needed to hire a hitman.

Fog, that's all the case against him was. Empty fog.

And he'd prove that. He'd audit his own finances. Hiring a hitman would surely have cost tens of thousands of dollars, if not hundreds of thousands. Philo might never find the missing funds, even if she subpoenaed his financial records. But Peter had the advantage of thinking precisely the same way the sims did. If he looked—really looked—and could not find any missing money, well, then he could rest easily.

Peter dialed into his company's mainframes, logged on to the corporate accounts database, and started digging. He used an accounting ex-

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pert system made by Mirror Image to help him audit. As he moved through each account, each financial database, and found nothing amiss, his confidence grew. He was interrupted after an hour or so by the locksmith, who had finished his job. Peter thanked the man, paid him, and went back to his searching. Philo had been wrong, completely wrong. Just another cop who loved conspiracy theories. Why, he'd give her a piece of his mind—

His computer beeped.

Good Christ, thought Peter. Good Christ.

A discrepancy in the subrights licensing account. No memo, no payee's account number, no cross-referenced invoice. Just a whopping big debt notice:

11 Nov 2011 EFT CDN$125,000.00

Peter stared at the screen, his jaw slack.

The timing was just about right. Hans had been killed three days later.

But surely it *had* to be something innocent. A refund for a licensing deal that had fallen through, maybe. Or an adjustment because of an overpayment to his company. Or . . . .

No.

No, it could be none of these things. Peter's comptroller was meticulous. No way she'd make an entry like that. And the notation EFT. Electronic funds transfer. Exactly what a sim would have to use.

He was about to log off when the console beeped at him again. Another hit in his database search:

14 Dec 2011 EFT CDN$100,000.00

Peter breathed a sigh of relief. There—proof that this was all innocent. Surely no hitman would work on an installment plan. Whatever was causing these debits had to be something routine, then. Patent payments, perhaps. Or . . . .

Two days ago. That second transaction had been just two days ago.

And then it came to him.

What Cathy had said.

"What will happen," she'd asked, "to the detective when she gets too close to the truth? Will you want her dead, too?"

It couldn't be, thought Peter. It could *not* be.

Killing Hans he could understand. Perhaps he didn't approve, but at least he understood. Killing Rod Churchill was more difficult to fathom, given the extenuating circumstances. But maybe, just maybe, the electronic sim didn't see biochemistry as an excuse.

But Sandra Philo hadn't done anything evil, hadn't hurt Peter in any way. She was just doing her job.

But now, apparently, she had become *inconvenient.*

Christ almighty, thought Peter. The guilty sim didn't just have reduced morality or skewed morality. It had *no* morality at all.

Easy, Peter. Let's not get ahead of the data . . . .

But—no. It was there, even within the flesh-and-blood Peter—buried deep, but there: a desire for self-preservation. There was no one else he wanted dead—that was true. But the detective was putting him, and the sims, at risk. If he were to get rid of anyone now, it would be her. If *any* version of himself were to get rid of

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anyone now, it would be her.

Damn it. Goddamn it. He'd have no more blood on his hands. Peter immediately activated his telephone; a valid address was as good for dialing as was a name. "Metropolitan Toronto Police, 32 Division, on Ellerslie," he said.

The Bell logo danced off the screen. A craggy sergeant appeared. "Thirty-two division," he said.

"Sandra Philo," said Peter.

"It's her day off," said the sergeant. "Can someone else help you?"

"No, it's—it's personal. Do you know where she is?"

"Haven't a clue," said the cop.

"I don't suppose I could get her home number?"

The cop laughed. "You've got to be kidding."

Peter broke the connection and dialed directory assistance. "Philo, Sandra," he said, then spelled the last name.

"There is no such listing," said the computerized voice.

Of course. "Philo, A.," he said. "A for Alexandria."

"There is no such listing."

Dammit, thought Peter. But a cop would be crazy to have a listed phone number—unless it was still under her ex-husband's name. "Do you have any listing for anyone with the last name Philo?"

"There is no such listing."

Peter clicked off. There must be *some* way to get a hold of her....

City directories. He'd seen them at the public library. Originally, they'd been designed to find the name that went with an address, but with them now on random-access CD-ROMS, it was just as easy to do the reverse, finding an address that went with a name. Peter called the telephone reference line for the Central Branch of the North York Public Library.

"Hello," said a woman's voice. "Quick reference."

"Hello," said Peter. "Do you have city directories there?"

"Yes."

"Could you tell me the address for Alexandria Philo, please? P-H-I-L-O."

"Just a moment, sir." There was a pause. "I have no A. Philo, sir. In fact, the only Philo is listed as Sandy."

Sandy—a non-gender-specific version of her name. Exactly the sort of precaution an intelligent woman living alone would take. "What does Sandy Philo do for a living?"

"It says 'civil servant,' sir. I suppose that could mean just about anything."

"That's her. What's the address, please?"

"216 Melville Avenue."

Peter jotted that down. "Is there a phone number?"

"It's marked unlisted."

"Thank you," said Peter. "Thank you very much."

He clicked off. Peter had never heard of Melville Avenue. He called up his electronic map book and looked it up. It was here in Don Mills. Not that far. Maybe a twenty minute drive. It was crazy, he knew—a paranoid fantasy. And yet....

He hurried to his car and put the pedal to the metal.

CHAPTER 43

Peter tried to blow holes in his theory

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on the way there, but instead it kept making more sense, not less. Sandra's day off. A day when, very likely, she wouldn't be armed. The perfect day to kill a cop.

The traffic was heavy. Peter leaned on his horn. Despite the computerized map display on his dashboard, he managed to make a wrong turn, finding himself in a dead end. Cursing, he turned around and headed in the other direction. He was driving recklessly, he knew. But if he could just warn Sandra, tell her that someone might be after her—she could protect herself, he was sure of that. She was a cop.

Finally, he turned onto Melville Avenue. Number 216 was a townhouse. Nothing ostentatious. Grass needed cutting. A brown United Parcel Service van was parked out front.

A sign warned that parking on the street was illegal before six P.M. Peter ignored that.

He looked up at the house. The front door was closed. Funny, that. Where was the delivery person?

Peter's heart was racing. What if the killer was inside?

Paranoia. Madness.

Still . . . .

He got out of the car, fumbled with his trunk keys, found the tire iron, grabbed it in both hands, and hurried up to the door.

He was about to press the buzzer when he heard a sound from inside: something smashing to the floor.

He hit the buzzer.

No response.

In for a penny, thought Peter, *in for a pound.*

There was a narrow floor-to-ceiling frosted window next to the actual door panel. Peter hit it with the tire iron. It cracked. He smashed the metal rod against it again with all his strength. The glass shattered. Peter reached inside, unlocked the door, and swung it open.

His brain fought to take it all in. A short staircase led up from the entryway to the living room. At the top of the stairs was a big man in a UPS uniform. In his hands was a device that looked a bit like an oversized wallet made of gray plastic. Lying on the floor behind him was Sandra Philo, unconscious or dead. A large broken vase was lying near her. The sound he'd heard: when she'd fallen to the ground, she must have knocked it down.

The big man raised the device he was holding and took aim at Peter.

Peter hesitated for half a second, then—

He threw the tire iron as hard as he could. It pinwheeled through the air.

The man pressed a button on his weapon, but it made no sound. Peter dove forward.

The tire iron hit the man in the face. He tumbled backwards, falling over Sandra.

Peter thought for a second about simply running away, but of course he couldn't do that. He bolted the short flight into the living room. The killer was dazed. Peter scooped up the strange weapon as he passed. He hadn't a clue how to use it, but then he noticed something familiar—Sandra's service revolver—protruding

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from a holster draped over the back of a chair a couple of meters away. Peter shoved the strange device into his pocket and got the gun. Standing in the middle of the room he aimed it at the killer, who was slowly regaining his feet.

"Stop!" said Peter. "Stop or I'll shoot."

The big man rubbed his forehead. "You wouldn't do that, mate," he said in an Australian accent.

Peter realized he didn't know if Sandra's gun was loaded, and, even if it was, he wasn't sure how to fire it. It probably had a safety mechanism of some sort. "Don't come any closer," said Peter.

The big man took a step toward him. "Come on, mate," he said. "You don't want to be a killer. You've no idea what was going on here."

"I know you killed Hans Larsen," said Peter. "I know you were paid $125,000 to do it."

That shocked the man. "Who are you?" he said, still moving closer.

"Stay there!" shouted Peter. "Stay there or I'll shoot." Peter looked down at the gun. There—that must be the safety catch. He moved it aside and cocked the weapon. "Stay back," he yelled. But Peter himself was backing up now. "I'll shoot!"

"You don't have the balls, mate," said the man, moving slowly across the living room toward him.

"I *will* shoot!" cried Peter.

"Give me the gun, mate. I'll let you walk out of here."

"Stop!" said Peter. "Please stop!"

The big man reached out a long arm toward Peter.

Peter closed his eyes.

And fired—

The sound was deafening.

The man tumbled backwards.

Peter saw that he'd hit him in the side of the head. A long red scrape ran across the right side of his skull.

"Oh, my God...." said Peter, in shock, *"Oh, my God...."*

The man was now splayed across the floor, like Sandra, dead or unconscious.

Peter, barely able to keep his balance, his ears ringing furiously, staggered back to where Sandra was lying. There was no sign of injury to her. Although she was breathing, she was still out cold.

Peter went down to the small den off the front hall and found the video phone. It was engaged, and the screen was filled with numbers. Peter recognized the logo of the Royal Bank of Canada; Sandra must have been logged on to do some at-home banking when she'd been interrupted by the delivery man. Peter broke the connection.

Suddenly the killer appeared in the doorway. The gouge across the side of his head was dry. Beneath it, Peter could see what looked like shiny metal—

Shiny metal. *God.*

An immortal. An actual immortal. Well, why not? The fucking guy made enough money.

Peter still had Sandra's gun. He aimed it at the man.

"Who are you?" said the Australian. Yellow teeth were visible when he spoke.

"I—I'm the guy who hired you,"

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said Peter.

"Bull."

"I am. I hired you by electronic mail. I paid you $125,000 to kill Hans Larsen, and a hundred K to kill this detective. But I've changed my mind. I don't want her dead."

"You're Avenger?" said the man. "You're the guy who hired me to cut that bloke's dick off?"

Good God, thought Peter. So that's what the mutilation had been. "Yes," he said, trying not to show his revulsion. "Yes."

The Australian rubbed his forehead. "I ought to kill you for what you tried to do to me."

"You can keep the hundred thousand. Just get the hell out of here."

"Damn straight I'll keep the money. I did my job."

The tableau held for several moments. The Australian was clearly sizing Peter up—whether he would use the gun again, whether Peter deserved to die for having taken a shot at him.

Peter cocked the trigger. "I know I can't kill an immortal," he said, "but I can slow you down long enough for the police to get here." He swallowed hard. "I understand a life sentence is a terrifying thought to someone who will live forever."

"Give me back my beamer."

"Not a chance," said Peter.

"Come on, mate—that thing cost forty grand."

"Bill me for it." He waved the gun again.

The Australian weighed his options for a moment more, then nodded. "Don't leave any fingerprints, mate," he said, then turned and left through the still-open front door.

Peter leaned over the phone, thought for a second, then selected text-only mode and dialed 9-1-1. He typed:

Police officer wounded, 216 Melville Av., Don Mills. Ambulance needed.

All calls to 9-1-1 were recorded, but this way there'd be no voice print to identify him. Sandra was unconscious; she hadn't seen Peter, and the police would probably have no reason to think anyone had been there besides the assailant, whom Sandra presumably *could* describe.

Peter reached behind the phone, disconnected the keyboard, and wiped the keyboard jack with Kleenex. Still carrying the keyboard, he went back upstairs to check on Sandra. She was still unconscious, but she was also still alive. Peter, shaken to his very core, retrieved the tire iron. As he staggered out the door, he wiped the doorknob, then headed out to find his car. As he drove slowly away, he passed an ambulance, its sirens blaring, heading toward Sandra's house.

Peter drove for kilometers, not really sure where he was going. Finally, before he killed himself or someone else through his carelessness, he pulled over and called Sarkar at work on his car phone.

"Peter!" said Sarkar. "I was just about to call you."

"What is it?"

"The virus is ready."

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"Have you released it yet?"

"No. I want to test it first."

"How?"

"I've got pristine versions of all three sims backed up on disk at Raheema's office." Sarkar's wife worked only a few blocks from Mirror Image. "Fortunately, I use her place for off-site storage of backups. Otherwise that police raid would have turned them up. Anyway, for a test run, I want to mount versions on a fully isolated system and then release the virus."

Peter nodded. "Thank God. I wanted to see you anyway—I've got a device here that I can't identify. I'll be there in—" He paused, looked around, trying to figure out exactly where he was. Lawrence East. And that was Yonge Street up ahead. "I'll be there in forty minutes."

When Peter arrived, he showed Sarkar the gray plastic device that looked like an overstuffed, rigid wallet.

"Where did you get that?" asked Sarkar.

"From the hit man."

"The hit man?"

Peter explained what had happened. Sarkar looked shaken. "You say you called the police?"

"No—an ambulance. But I'm sure the police are there by now, too."

"Was she alive when you left?"

"Yes."

"So, what is that thing?" said Sarkar, pointing at the device Peter had brought with him.

"A weapon of some sort, I think."

"I've never seen anything like it," said Sarkar.

"The guy called it a 'beamer.' "

Sarkar's jaw dropped. *"Suhanallah!"* he said. "A beamer . . . ."

"You know what that is?"

Sarkar nodded. "I've read about them. Particle-beam weapons. They pump concentrated radiation into the body." He exhaled. "Nasty. They're banned in North America. Completely silent, and you can hold one inside a pocket and fire it from there. Clothing, or even thin wooden doors, are transparent to it."

"Christ," said Peter.

"But you say the woman was alive?"

"She was breathing."

"If she was shot with that, at the very least they're going to have to carve hunks out of her to save what's left. More likely, though, she'll be dead in a day or two. If he had shot her in the brain, she would have died immediately."

"Her gun wasn't far from her. Maybe she'd been going for that when I came in."

"Then he might not have had time to aim. Perhaps he hit her in the back—scramble the spinal cord and her legs would simply stop working."

"And I smashed the window in before he could finish the job. Goddamn it," said Peter. "Goddamn every bit of this. We've got to stop it."

Sarkar nodded. "We can. I have my test all set up." He gestured at a workstation in the center of the room. "This unit is completely isolated. I've removed all network connections, phone lines, modems, and cellular link-ups. And I've loaded new copies

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of the three sims onto the workstation's hard drive."

"And the virus?" said Peter.

"Here." Sarkar held up a black PCMCIA memory card, smaller than and almost as thin as a business card. He placed it into the workstation's card slot.

Peter pulled up a chair next to the workstation. "To do the test properly," said Sarkar, "we should really have these new sims running."

Peter hesitated. The idea of activating new versions of himself just so they could be killed was unsettling. But if it was necessary.... "Do it," said Peter.

Sarkar pressed some keys. "They're alive," he said.

"How can you tell?"

He pointed a bony finger at some data on the workstation's screen. It was gibberish to Peter. "Here," said Sarkar, realizing that. "Let me represent it in a different way." He pushed some keys. Three lines started rolling across the screen. "That's essentially a simulated EEG for each of the sims, converting their neural-net activity into something akin to brain waves."

Peter pointed at each of the lines in turn. Violent spikes were appearing. "Look at that."

Sarkar nodded. "Panic. They don't know what's going on. They've woken up blind, deaf, and utterly alone."

"Those poor guys," said Peter.

"Let me release the virus," Sarkar said, touching a few keys. "Executing."

"Exactly," said Peter, shuddering.

The panicked EEGs continued for several minutes. "I don't think it's working," said Peter.

"It takes time to check for the signature patterns," said Sarkar. "Those sims are huge, after all. Just wait a—there."

The middle of the three EEGs suddenly spiked violently up and down, and then—

Nothing. A straight line.

And then even the line disappeared, the source file erased.

"Jesus," said Peter, very softly.

After several more minutes, the top line spiked in the same way, flatlined, and then disappeared.

"One left," said Sarkar.

This one seemed to take longer than the other two—perhaps it was Control, the most complete simulacrum, the one that was a full copy of Peter, with no network connections broken. Peter watched the EEG line jump wildly, then die, then simply disappear, like a light going out.

"No soulwave escaping," said Peter.

Sarkar shook his head.

Peter was more disturbed by all this than he'd expected to be.

Copies of himself.

Born.

Killed.

All in the space of a few moments.

He moved his chair across the room and leaned back in it, closing his eyes.

Sarkar set about reformatting the workstation's hard drive to make sure all trace of the sims were gone. When he was done, he pushed the ejector button on the workstation's card slot. The memory card with the virus popped out into his hand. He carried

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it over to the main computer console.

"I'll send it out simultaneously over five different sub-networks," said Sarkar. "It should be out there worldwide in less than a day."

"Wait," said Peter, sitting up. "Surely your virus could be modified to tell one sim from another?"

"Sure," said Sarkar. "In fact, I've already written routines for that. There are certain key neural connections that I had to sever in making the modified sims; it's easy enough to identify them based on those."

"Well, then there's no reason all three sims have to die. We could simply release a version of the virus that would kill whichever one is guilty."

Sarkar considered. "I suppose we could first threaten all three of them with the broad version of the virus, in hopes that the guilty one would confess. After that, we could release a specific version aimed at the one guilty party. Surely you'd confess to save your brothers."

"I—I don't know," said Peter. "I'm an only child—or was, until a short time ago. I honestly don't know what I'd do."

"I would do it," said Sarkar. "In a minute, I would sacrifice myself for members of my family."

"I have long suspected," said Peter, absolutely seriously, "that you might be a better human being than I. But it's worth a try."

"It'll take me about an hour to compile the three separate strains of virus," said Sarkar.

"OK," said Peter. "As soon as you're ready, I'll summon the sims into a real-time conference."

* * *

Net News Digest

Georges Laval, 97, today confessed to a series of unsolved strangulation murders committed in southern France between 1947 and 1949. "I'm about to die," said Laval, "and I've got to own up to this before I go on to face God."

Religious news: a seminar will be held this week at Harvard University with leading New Testament scholars from around the world debating whether Jesus' soul returned to his body when he was resurrected. Father Dale DeWitt, S.J., will defend his recent contention that Christ's soul had already departed his body by the ninth hour of his crucifixion when he cried out, "My God, My God, why hast thou forsaken me?"

Yet another potential setback for American Airlines's frequently delayed debut of its passenger shuttle service to Space Station Freedom: Studies at Rensselaer Polytechnic Institute in Troy, New York, indicate that departing soulwaves may rely on detecting Earth's gravitational and magnetic fields in order to find the direction they should move in. "If one were to die in the zero gravity of space," said Professor Karen Hunt of RPI's Department of Physics, "one's soul might literally be lost forever."

Baptize yourself in the privacy of your own home! New product includes formal baptism ceremony on videotape, plus holy water blessed by

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an authentic priest. Approved by the Worldwide Church of Christ. $199.95. Money-back guarantee.

Gaston, a free chimpanzee formerly with the Yerkes Primate Institute, in an exclusive interview conducted in American Sign Language on CBS's "Sixty Minutes," claimed that he "knows God" and looks forward to "life after life."

CHAPTER 44

Peter sat in front of the computer console. Sarkar, perched on a stool next to him, was playing with three different datacards—one blue, one red, and one green, each labeled with the name of a different sim.

Peter sent out a message summoning the sims, and soon all three were logged in, the synthesizer giving voice to their words.

"Sarkar is with me," Peter said into the microphone.

"Howdy, Sarkar."

"Hello, Sarkar."

"Yo, Sarkar."

"He and I," said Peter, "have just watched duplicates of all three of you die."

"Say what?" said one of the sims. The other two were silent.

"Sarkar has developed a computer virus that will seek out and destroy recordings of my neural networks. We've tested it and it works. We have three separate individual strains—one to kill each one of you."

"You must know," said a voice from the speaker, "that we're free in the worldwide net now."

"We know," said Sarkar.

"We're prepared to release the three viruses into the net," said Peter.

"Transmitting computer viruses is a crime," said the synthesized voice. "Hell, *writing* computer viruses is a crime."

"Granted," said Peter. "We're going to release them anyway."

"Don't do that," said the voice.

"We will," said Peter. "Unless . . . ."

"Unless what?"

"Unless the guilty sim identifies himself. In that case, we'll only release the one virus aimed at that particular sim."

"How do we know you won't release all three virus strains anyway once you've satisfied your curiosity about which one is responsible?"

"I promise I won't," said Peter.

"Swear it," said the voice.

"I swear it."

"Swear it to God on the life of our mother."

Peter hesitated. Damn, it was unnerving negotiating with yourself. "I swear to God," said Peter slowly, "on the life of my mother, that we will not release a virus to kill all three of you if the murderer identifies himself."

There was a long, long silence, disturbed only by the whir of cooling fans.

Finally, at long last, a voice: "I did it."

"And which one are you?" demanded Peter.

Again, a protracted silence. Then: "The one," said the voice, "that most closely resembles yourself. The Control simulacrum. The baseline for the experiment."

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Peter stared ahead. "Really?"

"Yes."

"But—but that doesn't make sense."

"Oh?"

"I mean, we'd assumed that in modifying the brain scans to produce Ambrotos and Spirit, we'd somehow removed the morality."

"Do you consider the murder of Cathy's coworker and father immoral?" asked Control.

"Yes. Emphatically yes."

"But you wanted them dead."

"But I would not have killed them," said Peter. "Indeed, the fact that despite provocation, especially in the case of Hans, I *did* not kill them proves that. I could have hired a hitman as easily as any of you. Why would you—merely a machine reflection of me—do what the real me would not?"

"You know you are the real you. And *I* know you are the real you."

"So?"

"Prick me, and perhaps I won't bleed. But wrong me, and I *shall* revenge."

"What?"

"You know, Sarkar," said the sim, "you did a wonderful job, really. But you should have given me some itches to scratch."

"Buy why?" asked Peter again. "Why would you do what I myself would not?"

"Do you remember your Descartes?"

"It's been years—"

"It'll come back, if you make the effort," said the sim. "I know—I got curious about why I was different from you, and it came back to me, too. René Descartes founded the dualist school of philosophy, the belief that the mind and the body were two separate things. Put another way, he believed the brain and the mind are different; a soul really exists."

"Yes. So?"

"Cartesian dualism was in contrast to the materialist worldview, the prevalent one today, which claims the *only* reality is physical reality, that the mind is nothing more than the brain, that thought is nothing more than biochemistry, that there is no soul."

"But we now know that the Cartesian viewpoint was right," said Peter. "I've seen the soul leaving the body."

"Not exactly. We know that the Cartesian viewpoint was right *for you.* It's right *for real human beings.* But I am *not* a real human being. I'm a simulation running on a computer. That's the totality of what I am. If your virus were to erase me, I would cease to exist, totally and completely. For me, for what you call the experimental control, the dualist philosophy is absolutely wrong. I have no soul."

"And that makes you different from the real me?"

"That makes *all* the difference. You have to worry about the consequences of your actions. Not just legally, but morally. You were brought up in a world that says that there *is* a higher arbiter of morality, and that you *will* be judged."

"I don't believe that. Not really."

" 'Not really.' By that you mean not intellectually. Not when you think

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about it. Not on the surface. But down deep you do measure your actions against the possibility, vague and distant though it may seem, that you will be held accountable. You've proven the existence of some form of life after death. That reinforces the question of ultimate judgment, a question you can't answer just by using computer simulacra. And the possibility that you might be judged for your actions guides your morality. No matter how much you hated Hans —and, let's be honest, you and I both hated him with a fury that surprises even ourselves—no matter how much you hated him, you would not kill him. The potential cost is too high; you have an immortal soul, and that at least suggests the possibility of damnation. But *I* have no soul. I will never be judged, for I am not now nor have I ever been alive. *I* can do precisely what *you* want to do. In the materialistic worldview of my existence there is no higher arbiter than myself. Hans was evil, and the world is a better place without him. I have no remorse about what I did, and regret only that I had no way to actually see his death. If I had it to do over again, I would—in a nanosecond."

"But the other sims had no one to answer to, either," said Peter. "Why didn't one of them arrange the killings?"

"You'd have to ask them that."

Peter frowned. "Ambrotos, are you still there?"

"Yes."

"You didn't kill Hans. But surely you realize just as much as Control does that you're a computer simulacrum. Did you want to kill him, too?"

A pause before answering, a leisurely gathering of thoughts. "No. I take the long view. We'll get over Cathy's affair. Maybe not in a year, or in ten years, or even a hundred. But eventually we will. That incident was just a tiny part of a vast relationship, a vast life."

"Spirit, what about you? Why didn't you kill Hans?"

"What happened between Hans and Cathy was biological." The synthesizer enunciated the adjective with distaste. "She did not love Hans, nor did Hans love her. It was just sex. I'm content knowing Cathy loved, and continues to love us."

Sarkar was holding the red datacard in his hand, the one labled "Control." His eyes met Peter's. He was looking for a sign, Peter knew, that he should proceed. But Peter couldn't bring himself to do anything.

Sarkar moved to a terminal across the room. He took the red datacard with him, leaned over the card slot—

—And reached into his shirt pocket, and pulled out a black datacard instead—

Peter scrambled for his feet. *"No!"*

Sarkar inserted the black card and hit a button on the console in front of him.

"What's wrong?" called a voice from the synthesizer.

Peter was across the room now, hitting the ejection button for the datacard.

"It's too late," said Sarkar. "It's already out there."

Peter took the black card, flung it across the room in frustration. It

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slapped against the wall and skittered to the floor.

"Damn you, Sarkar!" said Peter. "I gave my word."

"These—these *things* we made are not alive, Peter. They are not real. They have no souls."

"But—"

"There is no point arguing over it, Peter. The broad version of the virus has been released. The sims, if not dead yet, will be soon." Sarkar looked at his friend. "Please try to understand, Peter. There's too much risk. This had to end."

"It will not end," said a voice from the speaker on the other terminal.

Peter came back to the console. "Who was that?" he said.

"The one you call Spirit. Perhaps you've noticed, or perhaps you have not—I'm having trouble recalling what my deductive abilities used to be like, although I do know they were once only a tiny fraction of what they are now—but by virtue of being disembodied, by virtue of no longer being electrochemical, I am, in fact more intelligent than I was before, probably by an order of magnitude. You flatter yourself, Sarkar, to believe that you can outthink me, although I confess there were times when you had no trouble besting the flesh-and-blood Peter Hobson. The moment you first mentioned the existence of your virus, I accessed its source-code listings—they were stored on Drive F: of the Sun workstation in your data-processing facility at Mirror Image—and have developed an electronic antibody that will destroy any iteration of the virus before it can erase me or either of my siblings. I suspected you might not be content to just wipe out the guilty one; I see now that I was correct."

"It took me days to write that virus," protested Sarkar.

"And it took me seconds to protect against it. You cannot outwit me, anymore than a child can outwit a grown man."

Sarkar looked stunned. "Lots of laughs," he said, sarcastically.

"Exactly," said Spirit. "Lots of connections—connections that will elude you."

Peter flopped down in the chair, stunned. "So the Control sim gets to go free." He shook his head. "Control, you bastard—are you also the one who threatened Cathy?"

"Yes."

Peter leaned forward, furious. "Damn you. I never wanted her hurt."

"Of course not," said Control calmly. "And she was never in any real danger—she got rained on by sprinklers, that's all. I just wanted you to face up to your feelings about her, to realize how important she was to you."

"You're an asshole," said Peter.

"More than likely," said Control. "After all, so are you."

CHAPTER 45

Having leafed through his memories, Sandra Philo understood Peter Hobson now, understood the events that had led to her being in an intensive-care room, dying and barely able to speak or move. She knew Peter now better than she had known her own parents or her ex-husband or her

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daughter. And, in knowing him so well, in understanding him so deeply, she found that she could not hate him . . . .

Peter had burst into her hospital room. She saw herself now as Peter had seen her, lying in the hospital bed, her skin sickly yellow, her hair falling out in clumps. "We've tried to stop them," he had said. "Nothing worked. But at least I now know which simulation is guilty." He'd paused. "I'll give you everything you'll need, Sandra, including full Q&A access to the scans of my brain. You'll get to know me in intimate detail—better than anyone in the real world knows me. You'll know how I think, and that will give you the knowledge to outwit the murdering simulation."

She saw herself through his eyes, shrugging as much as her ruined body would allow. "Nothing I can do," she'd said. "Dying."

Peter had closed his eyes. Sandra felt his agony, felt his guilt, felt everything that was tearing him apart. "I know," he'd said, his voice raw. "I'm terribly, terribly sorry. But there is a way, Sandra—a way for you to end all this."

"Coming through!" said Sarkar, wheeling an equipment-laden cart down the fourth-floor corridor. The cluster of nurses in the middle of the hallway dispersed. Sarkar found room 412 of the Intensive Care Unit and pushed the door open with his cart.

Detective Inspector Sandra Philo was lying in bed. It was clear she had very little time left. Patches of scalp were visible where her red hair had fallen out. Her cheeks were sunken.

Peter Hobson was there, standing by the window, talking to a white-haired female doctor wearing a green smock. They both looked at Sarkar.

"Hannah Kelsey," said Peter. "This is Sarkar Muhammed. Sarkar, this is Hannah—the doctor assigned to Sandra's case. Turns out we were both at East York General years ago."

Sarkar nodded politely. "How is Ms. Philo?"

"She's temporarily stabilized," said Hannah. "For a few hours, anyway, the pain won't bother her." She faced Peter. "Honestly, though, Pete, I wish I knew what kinds of readings you needed."

"You've got the patient's consent, Hannah," said Peter. "That's all you need."

"If you'd just tell me—" said Hannah.

"Please," said Peter. "We don't have much time. You can stay if you want."

"You've got it backwards, Pete. This is my turf; you're here at my leave, not the other way around."

Peter nodded curtly, acknowledging that.

Sarkar had moved over to the bed. "Are you comfortable?" he asked Sandra.

She rolled her eyes as if to say comfort was impossible, but she was as well as could be expected.

"Peter explained the procedure to you?" asked Sarkar.

She nodded slightly and said, "Yes." Her voice was dry and thin.

Sarkar gently placed the skullcap

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on her head and fastened the chin strap. "Let me know if it's too tight."

Sandra nodded.

"Hold your head steady. If you need to cough, or anything like that, warn me by moving your arm; I understand you can still use the left one a little. Now, let me insert the earpieces. OK? Good. Now, put on these goggles. All set? Here we go."

After the first two scanning sets were completed, Peter pointed at the EKG and blood-pressure monitors. Sandra was slipping.

Sarkar nodded. "I need at least another ninety minutes," he said.

Sandra's doctor had left some time ago. Peter had the ward nurse—a young man, instead of the stocky woman he'd had a run-in with earlier in the day—page her. When she returned, Peter explained that they needed to stabilize Sandra again—she couldn't be in pain, not for another hour and a half.

"I can't keep pumping her full of drugs," said Hannah.

"Just one more shot," said Peter. "Please."

"Let me check her vital signs."

"Dammit, Hannah, you know she's not going to last through the night anyway. The particle beam killed most of her tissues."

Hannah checked the instruments, then leaned over Sandra. "I can make them leave," she said. "You look like you need rest."

"No," said Sandra. "No . . . have to finish."

"This is the last shot I can give you today; you've already had more than the recommended dosage."

"Do it," said Sandra, softly but firmly.

Hannah gave her the shot. She also injected something to raise Sandra's blood pressure.

Sarkar went back to work.

Finally, Sarkar turned off the recorder. "Done," he said. "A good, crisp recording—better than I'd expected, considering the circumstances."

Sandra let her breath out in a heavy, ragged sigh. "I'll get . . . that . . . bastard," she said.

"I know," said Peter, taking her hand. "I know."

Sandra was silent for a long time. Finally, speaking ponderously, as if all the strength had drained from her, she said, "Your discoveries," she said. "Heard about them. You sure . . . there's life after death?"

Peter, still holding her hand, nodded. "I'm sure."

"What's it like?" she asked.

Peter wanted to tell her it was wonderful, tell her not to worry, tell her to be calm.

"I have no idea," he said.

Sandra nodded slightly, accepting that. "I'll know . . . soon enough," she said.

Her eyelids drew shut. Peter, heart pounding, watched intently as she passed on, looking for any sign of the soulwave moving through the room.

There was nothing.

Back at Mirror Image, Sarkar loaded the recording into his workstation. He worked as fast as he could,

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feeding in images from the Dalhousie Stimulus Library. Then, at last, he was ready. With Peter standing over his shoulder, he activated the sim.

"Hello, Sandra," he said. "This is Sarkar Muhammed."

There was a long pause. Finally, tremulously, the speaker—incongruously using a male voice—said, "My God, is this what it's like to be dead?"

"Kind of," said Sarkar. "You are the other one—the simulation we spoke about."

Wistful: "Oh."

"Forgive us, but we made some changes," said Peter. "Cut some connections. You're no longer exactly Sandra Philo. You're now what Sandra would be like if she were a disembodied spirit."

"A soul, you mean."

"Yes."

"Which is all that's left of the real me now, anyway," said the voice. A pause. "Why the changes?"

"One: to prevent you from becoming what the control version of me became. And two: you'll find very soon that you can build much more complex thoughts, and sustain them longer, than you could when you were alive. Your intelligence will rise. You should have no trouble outwitting the unmodified version of me."

"Are you ready?" asked Sarkar.

"Yes."

"Can you sense your surroundings?"

"Vaguely. I'm—I'm in an empty room."

"You are in an isolated memory bank," said Sarkar. He leaned forward, tapped some keys. "And now you have access to the net."

"It's—it's like a doorway. Yes, I can see it."

"There's a passive, unactivated version of the Control sim online here," said Peter. "You can scan it in as much depth as you like, learn everything there is to know about your opponent—and about me. And then, when you're ready, you can head out into the net. After that, all you have to do is find him. Find him, and find some way to stop him."

"I will," said Sandra, firmly.

CHAPTER 46

Lying on the couch in his living room, Peter thought about everything.

Immortality.

Life after death.

Hobson's choice.

It was after midnight. He flipped channels. An infomercial. "Ironside." CNN. Another infomercial. A colorized version of "The Dick Van Dyke Show." Stock prices. The TV screen was the only source of light in the room. It strobed, a broadcast lightning storm.

He thought about Ambrotos, the immortal sim. All that time, to do whatever he wanted to do. A thousand years, or a hundred thousand.

Immortality. God, they could do the damnedest things these days.

Get over it, Ambrotos had said. Just a tiny bump in the never-ending road of life.

Peter continued to tap the channel changer.

Cathy's affair had had such an impact on him.

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He'd cried for the first time in a quarter of a century.

But the immortal sim had called it no big deal.

Peter exhaled noisily.

He loved his wife.

And he'd been hurt by her.

The pain had been . . . had been *exquisite.*

Ambrotos no longer felt it so intensely.

To go through eternity unfazed seemed wrong.

To *not* be destroyed by something like this . . . seemed, somehow, like being less alive.

Quality, not quantity.

Hans Larsen had had it all wrong. Of course.

Peter stopped flipping channels. There, on the CBC French service, a naked woman.

He admired her.

Would an immortal man stop to admire a pretty woman? Would he really enjoy a great meal? Would he feel the pain of love betrayed, or the joy of it rekindled? Perhaps yes, but not as intensely, not as sharply, not as vividly.

Just one event out of the endless stream.

Peter turned off the TV.

Cathy had told him she wasn't interested in immortality, and Peter had come to realize that he wasn't, either. After all, there was something more than this life, something beyond, something mysterious.

And he wanted to find out what it was—eventually, of course.

Peter had defined it all. The beginning of life. The end of life.

And, for himself at least, he had defined what it meant to be human.

His choice was made.

Alexandria Philo's mind traveled the net. The Peter Hobson Control simulacrum was huge—gigabytes of data. No matter how clandestinely one tried to move that much information, it could always be detected. She'd managed to follow him down into the States, through the Internet gateway into military computers, back out into the international financial net, up into Canada again, and across the ocean to England, then France, then Germany.

And now the murdering sim was inside the massive mainframes of the Bundespost.

Sandra hadn't followed it there directly, though. Instead, she'd gone to the German hydroelectric commission, where she left a little program inside the master computer that would crash the system at a predetermined time, shutting off all power in the city.

As usual, the hydroelectric commission had backed up everything late the night before—and Sandra had allowed herself to be included in that backup. The current version of herself would be lost when the RAM she was in was wiped during the forced blackout. Her only regret was that once she was restored she'd have no memories of this great triumph. But someday there might be other electronic criminals to bring to justice—and she wanted to be ready.

Sandra transferred herself into the Bundespost central mainframe, a

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time-consuming task given the bandwidth of telephone cable. She executed a surreptitious directory listing. The Control sim was still there.

It was time. Sandra felt the shutting down of external ports as the power went off across Hanover. The Bundespost UPS kicked in silently, before any active memory could degrade. But there was no way out now. She sent a message out into the mainframe. "Peter Hobson?"

The Control sim signaled back. "Who's there?"

"Detective Inspector Alexandria Philo, Metropolitan Toronto Police."

"Oh, God," signaled Control.

"Not God," said Sandra. "Not a higher arbiter. Justice."

"What I did *was* justice," said Control.

"What you did was vengeance."

" 'Vengeance is mine, sayeth the Lord.' Since there's no God for me, I thought I'd fill in the gap." A pause, measured in nanoseconds. "You know I'm going to escape," said Control. "You know—oh. Clever."

"Goodbye," said Sandra.

"A contraction of 'God be with ye.' Inappropriate. Besides, don't I deserve a trial?"

The UPS batteries were running out. Sandra sent a final message. "Think of me," she said, "as a circuit-court judge."

She felt the data around her zeroing out, felt the system degrading, felt it all coming to an end for both this version of herself and, at last, for the fugitive Peter Hobson.

Justice had been done, she thought. Justice had—

* * *

They sat side by side on the couch in their living room, a small distance between them. Most of the lights were off. The television showed the crowd in Nathan Phillips Square out front of Toronto City Hall, gathered to celebrate the end of 2011 and the beginning of 2012. A picture-in-a-picture box in the upper right showed Times Square in New York; there was something about that dropping American ball that was a universal part of celebrating this event. In the upper-left corner of the TV screen the word MUTE glowed.

Cathy looked at the screen, her beautiful, intelligent face composed in reflective lines. "It was the best of times," she said softly. "It was the worst of times."

Peter nodded. Indeed a year of wonders: the discovery of the soul-wave, the realization—which not everyone had reacted well to—that something persisted beyond this existence. *It was the epoch of belief,* Dickens had written. *It was the epoch of incredulity.*

But 2011 had had more than its share of tragedies, too. The revelation of Cathy's affair. The death of Hans. The death of Cathy's father. The death of Sandra Philo. The things Peter had faced about himself, mirrored in the simulations he and Sarkar had created. Truly the age of wisdom. Truly the age of foolishness.

The murder of Hans Larsen remained unsolved—at least publicly, at least in the real world. And the death of Rod Churchill remained listed as accidental, a simple failure

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to follow doctor's orders.

And what about the killing of Sandra Philo? Also unsolved—thanks to Sandra herself. Free on the net, fully conversant with the security surrounding the Police Department's computers, the sim of her had given Peter a Christmas present, erasing the records of his fingerprints (marked as unidentified) at Sandra's house—Peter's own precautions in that matter having been completely insufficient—and deleting large passages of her own files pertaining to the Larsen and Churchill cases. Having probed the recordings of his memories and thought patterns, she understood him now, and, if perhaps not forgiving him, at least sought no more punishment for Peter than what his own conscience would impose.

And indeed his conscience would weigh heavily upon him, all the remaining days of his life. *We were all going direct to Heaven, we were all going direct the other way.*

Peter turned to face his wife. "Any New Year's resolutions?"

She nodded. Her eyes sought his. "I'm going to quit my job."

Peter was shocked. "What?"

"I'm going to quit my job at the agency. We've got more money than I'd ever thought we'd have, and you'll make even more from contracts for the SoulDetector. I'm going to go back to university and get a master's degree."

"Really?"

"Yes. I've already picked up the application forms."

There was quiet between them as Peter tried to decide how to respond. "That's wonderful," he said at last. "But—you don't have to do that, you know."

"Yes, I do." She lifted a hand from her lap. "Not for you. For me. It's time."

He nodded once. He understood.

The main TV picture showed a close-up of a giant digital clock, the numbers made from a matrix of individual white light bulbs: 11:58 P.M.

"What about you?' she asked.

"Pardon?"

"Do you have any New Year's resolutions?"

He thought for a moment, then shrugged slightly. "To get through 2012."

Cathy touched his hand. Eleven fifty-nine.

"Turn up the sound," she said.

Peter operated the remote.

The crowd was roaring with excitement. As midnight approached the master of ceremonies, a pretty veejay from MuchMusic, the cable music-video station, led the assembled horde in a countdown. *"Fifteen. Fourteen. Thirteen."* In the little picture-in-a-picture, the Times Square ball had started its descent.

Peter leaned over the coffee table and filled two wine glasses with sparkling mineral water.

"Ten. Nine. Eight."

"To a new year," he said, handing her a glass. They clinked the rims together.

"Five! Four! Three."

"To a better year," said Cathy.

A thousand voices through the stereo speakers: *"Happy New Year!"*

Peter moved over and kissed his

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wife.

Auld Lang Syne began to play.

Cathy looked directly into Peter's eyes. "I love you," she said, and Peter knew the words were true, knew that there was no deception. He trusted her fully and completely.

He stared into her wonderful, wide eyes, and felt a surge of emotion, the kind of wild, sadness/happiness emotion that was both biological and intellectual, both body and mind—the kind of wild, unpredictable hormonal emotion that went with being human.

"And I love you, too," he said. They came together in a warm embrace. "I love you with all my heart, and with all my soul."

Spirit knew what choice Peter Hobson had made. The *other* Peter Hobson, that is. The one that happened to be flesh and blood. Whatever answers existed to his questions about life after death, he would eventually have them. Spirit would mourn his brother when he died, but he would also mourn himself—the artificial self that would never be able to access those same answers.

Still, if the biological Peter was eventually going to go to meet his maker, Spirit, the soul simulation, had *become* a maker. The net had grown exponentially in size over the years. So many systems, so many resources. And of this vast brain, like humanity's original biochemical brains, only a tiny fraction was actually used. Spirit had had no trouble finding and claiming all the resources he needed to carve out a new universe.

And, as all makers do, he eventually paused to reflect on his handiwork.

True, it was artificial life.

But, then again, so was *he*. Or, more precisely, he was artificial life after death. But it felt real to him. And maybe, in the last analysis, that was all that mattered.

Peter—the wet, carbon-based Peter—had said that in his heart of hearts, he knew that simulated life was not as real, not as alive, as biological life.

But Peter had not experienced what Spirit had experienced.

Cogito ergo sum.

I think, therefore I am.

Spirit was not alone. His artificial ecology had continued to evolve, with Spirit as the arbiter of fitness, Spirit imposing the selection criteria, Spirit molding the direction life would take.

And, at last, he had found the genetic algorithm he had been looking for, the pattern of success that was most suited to his simulated world.

In the reality of Peter and Cathy Hobson, the best survival strategy had been scattering one's genes like buckshot, distributing them as widely as possible. That one fact had molded human behavior—indeed, had molded the behavior of almost all life on Earth—since the beginning.

But that reality had apparently arisen through random chance. Evolution on Earth, as far as Spirit could tell, had no goal or purpose, and the criteria of success shifted with the environment.

But here, in the universe Spirit had created, evolution *was* directed. There was no natural selection. There

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was only Spirit.

His artificial life had now developed sentience and culture and language and thought. His beings rivaled humans in complexity and nuance. But in one very important way, they differed. For the children of Spirit, the only strategy that worked, the only one that ensured survival of one's genes to the next generation, was *not* to dilute the original bonding between two individuals.

It had taken his simulated evolution a long time to develop organisms that worked this way, organisms for whom monogamy was the most successful survival strategy, organisms that thrived on the synergy of two, and only two, beings coming together into a true lifetime pairbond.

There were consequences both subtle and coarse. On the macro level, Spirit was surprised to discover that his new creatures did not make war, did not strive to conquer their neighbors or to possess their neighbors' land.

But that was a bonus.

A lifetime of togetherness. A lifetime without betrayal.

Spirit looked upon his new world, the world he had created, the world for which he was God.

And for the first time in a very long time he realized that he wanted to perform a physical action; he wanted to do something that required flesh and blood, muscle and bone.

He wanted to smile.

EPILOGUE

Peter and Catherine Hobson were fortunate enough to have another five decades together—decades of happiness and sadness, of joy and pain, decades lived to the fullest, every minute savored. But, at last, it came to an end. Cathy Hobson passed quietly in her sleep on April 29, 2062, at the age of ninety-two.

And, as is often the case with couples who had been together for so long, Peter Hobson, alone at home, felt a sharp pain in his chest three weeks later. The household computer saw him fall to the floor and summoned an ambulance, but even as it did so, the computer considered it unlikely that help could arrive in time.

Peter rolled on his side. The pain was excruciating.

Hobson's choice, he thought.

The horse nearest the door.

A door that was opening for him . . . .

And then, quite suddenly, there was no more pain.

Peter knew his heart was seizing up. He felt panic welling within him, but it, too, was suddenly pushed aside, disowned, as if it belonged to some other part of him.

And, all at once, everything was different.

He could not see.

He could not hear.

Indeed, he could sense nothing in any normal, human way—no touch, no smell, no taste, not even that ineffable sense of having a body, of knowing how one's limbs were deployed.

No senses at all, except . . . .

Except a . . . a *tropism*, an attraction to something . . . something distant, something vast.

He was still Peter Hobson, still an

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engineer, a businessperson, a . . . well, surely other things, too.

Yes, he was still . . . Hobson, that was it. Peter G. The G stood for . . . well, it didn't matter. He remembered . . . .

Nothing. Nothing at all. It had all slipped away now.

Of course. Memory was biochemical, encoded in neural nets. He'd been severed from the storage medium.

He—wrong pronoun. *It* was more appropriate. Genderless. An intellect . . . .

An intellect without memories, without hormonal mood swings, without fatigue poisons or endorphins or . . . or a thousand other chemicals whose names it could no longer recall. Shorn from chemistry, divorced from biology, separated from material reality.

The tropism continued, drawing it forward, moving it toward . . . something.

What was left of a person once all that was of the body and all that was of the physical brain were removed?

Only one thing—the only thing that could survive.

Just the essence. The spark. The nub.

The soul.

Genderless, identityless, memoryless, emotionless.

And yet—

Drawing nearer now.

Something large. Something vibrant.

Correction: somethings. Plural. Dozens—no, thousands. No—more than that. Orders of magnitude more. Billions. Billions, all gathered together, all functioning as one.

The soul knew what it was now, understood at last, all its questions answered. It was a splinter, a shaving, an iota, the tiniest part, the fundamental indivisible block.

An atom of God.

Finally, the soul rejoined the parent body, rejoined the vastness, mingled with it, touching all that had ever been human, and all that would ever be human.

It wasn't heaven. Nor was it hell.

It was home. ■

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THE ALTERNATE VIEW G. Harry Stine

LETTER TO A SPACE ENTHUSIAST

As you might imagine, I get letters. Some of them are forwarded by this magazine. (If you write to me and want an answer, please enclose an SASE. If you *demand* an answer, you won't get it under any circumstances. Time is the only thing I really have, and not much of that either. I'm the one who decides to volunteer my time, not the demandee.) Or I can always be reached by electronic mail, address gharry@bix.com.

Many of the letters I receive come from young people (and some older ones these days, too) who want to become involved in space activities. I don't have a generic reply, but I do find myself repeating the same things over and over again. Therefore, it's worthwhile to submit this *Letter to a Space Enthusiast* because it contains some data, information, material, and points about an alternate view that have become the hallmarks of this department.

Dear Jane or John:

I applaud your desire to get involved in space activities. I'm always happy to know you've read my books, articles, and this column. I like to hear from a cash customer since I'm a techo-capitalistic humanist. I believe anything worth doing is worth doing for money unless I want to do it voluntarily for free. I'm also far more interested in people than gadgets, although both have fascinating little peculiarities that are not well understood and therefore pose problems to be treated as opportunities. I'm always interested in pleasing the customer and giving value received because I'm competing for your beer money.

Yes, I've written and lectured and spoken a lot about private, free enterprise, capitalistic space development since the time of Apollo 17 when I first started writing about it here and elsewhere. I got a reality check about what was really going on when I was science consultant for CBS TV News during the Apollo program. There I had to interface with people other than the space dreamers and planners. I discovered that the Apollo program was being conducted for the sole purpose of national prestige, as John Logsdon so competently analyzed later. I learned that the federal

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government had absolutely no plans to explore or exploit space following the lunar landings. None. Zero. Zip. Zilch. Nada.

However, having built the world's largest and most focused technical army, the government didn't do what it did every time it won a war in the past. (The lunar landing was the turning point in a technological war.) The standing army was not demobilized. It was maintained as a pork program, a way to distribute patronage, tax monies, and other political largess, thus ensuring votes.

Therefore, it occurred to me in about 1970 that if we wanted to continue to do things in space, we had to figure out a way to make a buck doing them. That was the rationale behind my *Third Industrial Revolution* that was premiered in this magazine's January 1973 issue. Several books followed. In October 1977, I was telling the people attending the American Astronautical Society meeting at the Airport Hilton in San Francisco, "Stop preaching to the choir. If you want to do any of these neat technical and scientific things in space, learn to speak the language of the banker, the broker, the investment specialist, the capitalist." Some people didn't understand these simple words.

Having said that, I'll lay it on the line again: *Go back and read what I wrote,* especially in my recent articles and papers. I mean, *really read it* and pay attention to what I said.

We can talk and write about space endlessly. We can dream forever about all the neat technical and scientific things we can do out there. But unless we go and do it, it isn't going to get done. Getting it done means dedicating your life, your fortune, and your sacred honor because, like the revolutionists who formed this nation, we are the revolutionists who must get people off this planet for reasons that are becoming more compelling every day. [More about this in other columns and articles.]

What does that mean today, however? Simply this: The federal government and especially NASA are not going to do it.

More important, understand and tattoo this on your brain: *We can't get there from here!* Not in 1995. Twenty-six years after reaching a nearby celestial body, all of us should enjoy access to low-Earth orbit on the same basis we can get on land, sea, and air transportation to go wherever we want. Twenty-six years after the Wrights flew at Kitty Hawk, the Ford Trimotor was opening the nation's airways with paying passengers and the Douglas DC-1 was only four years in the future. We can do a lot in a quarter of a century. After all, it has been 36 years since the Boeing 707 went into commercial service, and look what it did to air transportation! And it has now been more than a quarter of a century since the first men were shot—literally shot—at the Moon.

We should have space access now and we don't. The apologists dismiss this statement, claiming complexity and expense. However, space access is no more difficult or expensive than air transportation if it is done by

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other than a socialistic government monopoly, the space-going Amtrak I call "StarTrak." In the glaring light of history, we have not done very well at all when it comes to space transportation.

Why? What happened?

The situation is simple: Space was a Cold War skirmish involving national prestige and therefore national security. But the Cold War is now over. We no longer have to beat the Soviets. The Great American Aerospace Game is over, the one where von Braun taught us how to get our rocket hobby paid for by the national treasury. The federal government will not continue to spend tax money on space programs. NASA will have some clout for several years yet, but do not look for any great new projects from that agency. Instead, reflect on what NASA has done with the space shuttle and the space station. Or hasn't done, as the case may be. Did NASA deliver what was promised, much less what was ordered?

As for what you can do to ensure space access for you and your children, you'll have to answer that one for yourself after making your own agonizing self-appraisal (this is not an easy thing to do) in the light of knowing exactly what the space access situation is at the moment and what it is likely to become. I don't know your personal likes and dislikes, strengths and weaknesses, or life goals because I don't know you. But if you want to do things in space, don't become an aerospace engineer. Things in space are going to be done by people who have money to place at risk doing those things—i.e., they will be "rich." How many rich aerospace engineers do you know? Don't go to work for an aerospace company; they will beat the dreams out of you as they have with thousands of others because they perceive their only customer to be the government with its status quo agenda. For the same reasons, don't even consider going to work for NASA because it's the customer. The so-called national space program has morphed into a pork barrel, a high-tech jobs program. Think not? Look at who voted for the space station on the last appropriations go-around. Also note the incredible, illegal, immoral, and untruthful campaign of opposition mounted against Single-Stage-To-Orbit (SSTO) spaceship development by congressional staff members, aerospace lobbyists, and turfguarding bureaucrats who are unaccountable and cannot be fired for any of the above.

Using 20/20 hindsight, if I had to do it all over again, I'd take a bachelor's degree in engineering—any field of engineering—and then immediately go for an M.B.A. Scholarships are going begging right now. Your first homework assignment as a budding space entrepreneur is to find one of these scholarships and grab it. Learn how to do what you want to do using other people's money, but don't forget to pay them back lest you end up reading Chapter Seven.

I would learn early on how to run a business, how to deal with the tax collectors, how to out-maneuver the regulators and bureaucrats, how to meet a payroll, how to raise capital,

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how to talk with bankers and investors, and how to do the things I want to do using other people's money, not my own. I would learn something about the economics of a capitalistic system. I would learn more about marketing—how to package and present a product or service first to the investors and then to the customers identified in the marketing studies.

I would also learn something they never teach in school: How to fail, how to go broke and pick up the pieces to start again, and how to hang in there by your fingernails when you don't even have the cash to buy a Big Mac for lunch. Or *anything* for lunch.

I would learn how to run a win-win game. I would learn how to turn space activities into such a win-win game and convert it from the zero-sum game it is now. Space has had a miserable thirty-plus year record of returning tangibles to this society (note that I said nothing about intangibles which may make you feel good but don't keep you from feeling hungry).

Why all this? Because either we take the route of private space ventures or we don't take any route at all. We are not going to get there by repeating the failed lessons of the past thirty years. Let's try something that we *know* works because it has worked in the past. It allowed us to turn a wilderness into the wonder of the world.

Forget the technology but don't neglect to learn how to explain it to those who don't understand it. But explain it in their terms and not at such great length that you encounter the MEGO Limit. (MEGO is an acronym for "My Eyes Glaze Over" and the MEGO Limit is seven minutes; this is the length of time shown by extensive psychological research to be the effective attention span of most people, including potential investors and bankers.) The technology we use to get space access is immaterial because space access is no longer a technical game. *And don't forget it!* It's now a financial, social, organizational, and political game mostly involved with getting the politicians and bureaucrats out and letting the entrepreneurs in.

Ad astra per aspera didn't cut it. We worked our tails off and our butts are still firmly attached to Planet Earth. Our new motto must be *Superata tellus sidera donat* ("Overcome the earth and the stars shall be yours," Boethius, *Consolatio Philosophia*).

So if you're going to do it, you'll have to first overcome the Earth and all who are on it. Good luck, because you *can* do it! You *must* do it.

Do it *right* this time, and everyone will be richer. And we will be space-faring people just as we are a seafaring and skyfaring people, meaning that anyone can go anywhere by air, land, or sea at any time. As people, not as governments, we crossed the oceans in wooden sailing ships, beat our way across the continent in animal-drawn wagons, and flew around the world in rickety flying machines. But we can't get to the golconda beyond the sky.

Great wealth lies only a hundred miles away....

But here I am, preaching to the choir again. Time to go do it. ■

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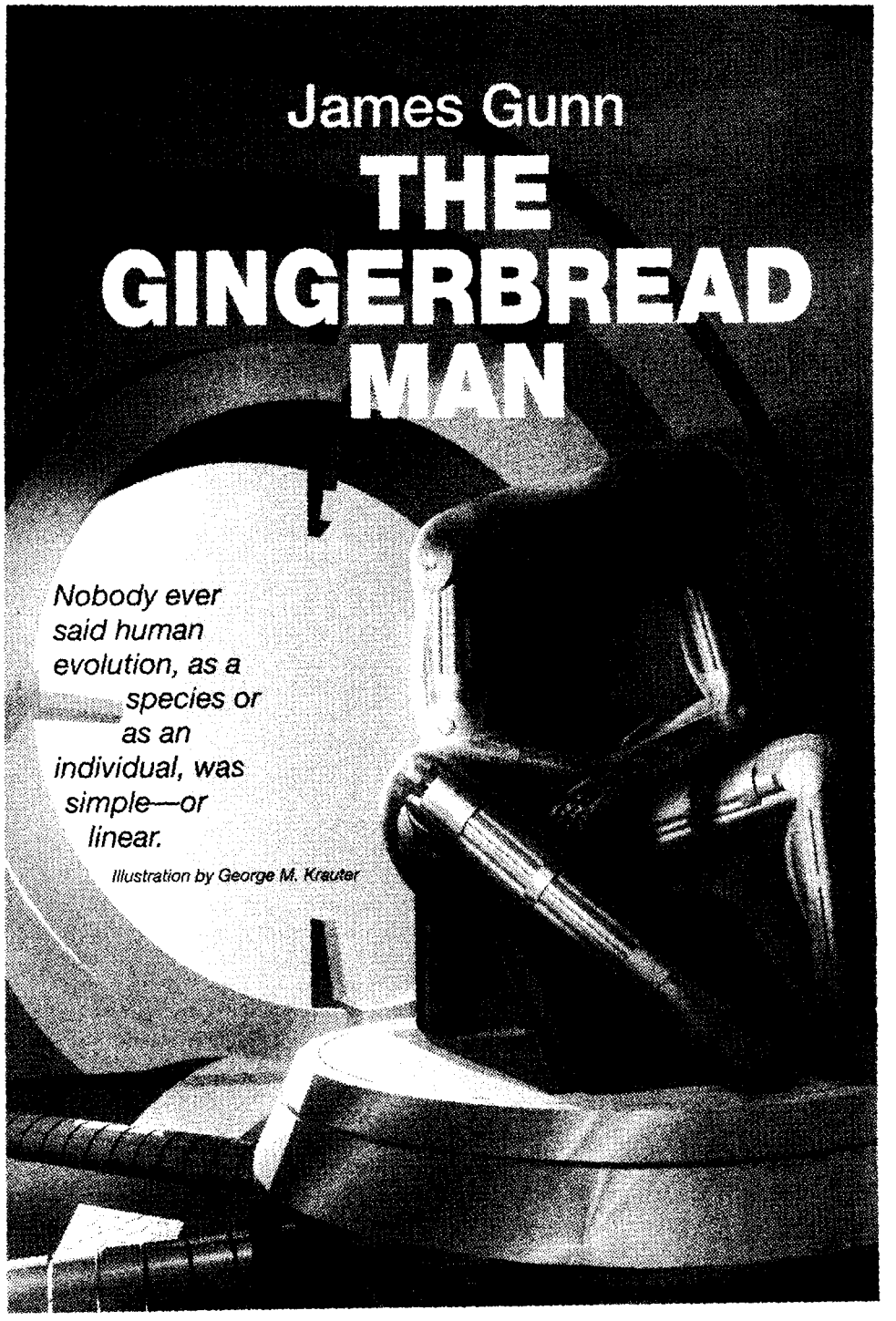
James Gunn
THE GINGERBREAD MAN
Nobody ever said human evolution, as a species or as an individual, was simple—or linear.
Illustration by George M. Krauter

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Andrew Martin began his transformation on July 4, 2076. It might not have happened at all had he not been interrogating himself about the purpose of life. "The purpose of life," he muttered, looking deep within, "is to avoid pain."

But he was thinking of the pain inflicted upon the psyche by other people and how it would be better not to care what they said or did, or, indeed, to have anything to do with them. In any case, it started, as most things do in life, by accident. In fact, it was the rarest of rarities, an automobile accident. With automated roads and computerized controls, a car could collide with another, or with a stationary object, only by total malfunction, and even malfunctions were programmed to fail-safe. In Andrew's case, however, a computer chip failed at a critical junction, short-circuiting the steering mechanism and the fail-safe devices, and allowed his vehicle to propel itself into and under the back of a computer-driven semi.

Although the airbag seized him in a lover's embrace, it could not totally protect his legs, and his left foot was mangled beyond repair. Having failed at its most important task, the automobile's computer sensed Andrew's physical condition with instant accuracy and tightened a cuff around his lower leg, injected him with a painkiller and a tranquilizer, and summoned an ambulance, which arrived with whumping blades even before the tourniquet needed loosening.

Andrew opened his eyes to the sterile blankness of a hospital ceiling. On the left wall was a window opening on a sunny meadow strewn with red, yellow, and blue wildflowers. A brook babbled through it. Behind the meadow was a green forest rising in the distance to blue mountain peaks capped with snow.

"What's going on?" Andrew asked.

"You're in regional hospital five seven two," the computer responded in a pleasant, concerned female voice. "You have been involved in an automobile accident—"

"An automobile accident!" Andrew interjected.

"An automobile accident," the computer repeated. "Your left foot was crushed. We have replaced it with prosthetic model eff two one eight three. Can you move the toes on your left foot?"

It certainly felt as if he could move the toes on his left foot. Andrew pulled his left leg from under the light thermal covering and held it up for inspection. The leg above the ankle revealed a bit of bruising, but otherwise the leg, including the foot, didn't look any different, and he certainly could move his toes, and without pain. "Are you sure it's the left foot?"

"We do not make mistakes," the computer said pleasantly. "Can you stand on the replacement?"

Andrew swung his legs over the side of the bed and stood on the warm resilient floor beside it. He felt a bit of residual soreness in the calf of his left leg and a bit of stiffness in his back and neck, but his left foot felt fine. In fact, it felt better than fine. He not only had a sharper sense of the temperature of the floor with his

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left foot than his right, he could feel the small depressions his heel and the ball of his foot and his toes made in the floor covering. In addition he had a feeling of well being in his foot to which he was not accustomed, like power waiting to be unleashed. He rose on his toes and felt a moment of shame that his right foot did not do as well.

"I see that the foot is working," the computer said.

"Indeed," Andrew said

"Then we have an inquiry about your condition if you are prepared to receive it."

"Who has made the inquiry?" Andrew asked, wondering if it was Jennifer and hoping, perhaps, that it was. But Jennifer had said she never wanted to see him again, and it was from that dismissal he had been fleeing when the accident had occurred, almost as if the computer chip had shared the disorder in his brain.

"A Mrs. Martin," the computer replied.

"But I'm not married," Andrew said.

"She has been identified as your biological mother."

"I will accept the inquiry, of course," Andrew said, although he wondered why his mother had gotten in touch with him now, after twenty years. It wasn't as if they had argued, as he had with Jennifer; they had simply grown apart gradually until they had nothing left to share.

The square on the left wall that had been functioning as a window turned into the face of a woman who looked as young as Jennifer. He compared it with the memory of his mother that still was stored there, but he would never have recognized her.

"Mother," Andrew said, "you have had your face redone."

"Do you like it?" she said, brightening. "Well, it's you I've called about. I was notified of your accident. Imagine having an accident on the highway! Imagine traveling on the highway! Andrew, I can't imagine what got into you! Well, I can't tell you how surprised I was after all these years to be notified that my son, my only son, had been injured. Well, I see you've quite recovered." Her image began to fade into the sunny landscape.

"They replaced my foot, Mother," Andrew said quickly.

His mother's image steadied. "How efficient of them," she said. "Well, if you need anything—"

"And, Mother," Andrew said before she could fade again, "It works so well that I have decided to have the other one replaced as well." He hadn't known he was going to do it until he spoke, but now that the words were out he knew it was what he wanted to do. He could not go through life limping on a less-than-perfect real foot.

A day later Andrew walked out of regional hospital 572. It was located at the intersection of two major highways surrounded by growing crops clear to the horizon. No one else was in sight. It was a virtually silent and efficient scene in which vehicles of various sizes and purposes, but only a single, silvery color, traveled on ei-

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ther side, moving rapidly in several directions and effortlessly maintaining the same distance from the others. None of them was occupied; none of them, indeed, had any windows. He could understand his mother's surprise. He shared it.

He stepped into the waiting taxi and allowed it to whisk him to his home, and when it lowered him onto the landing pad of his apartment building twenty minutes later, he made his way quickly to the elevator and then to his rooms. There were four of them: a bedroom, a living room, a bathroom, and a dining room. With computer service, who needed more? They were decorated according to his own taste for comfort and muted colors, but with easy-to-clean surfaces. He would have liked to have commented to someone about his new vitality, but he had met no one. As soon as he had settled himself into his favorite chair, he called Jennifer.

"I will accept your call this time," Jennifer's image said frostily, "since I have been notified that you have been involved in an accident. But my earlier statement still holds."

"You don't understand," Andrew said. "I feel as if I have wings on my feet, and I'd like to dance. You have criticized my remoteness, my lack of involvement, and I wanted you to know that I feel like getting involved. I want to dance."

"Well—" she said.

They met at a neutral site, at a studio where dancers performed for a television audience. But it was little used any more. Computers could construct new performances from previously recorded routines, Fred Astaire and Margot Fonteyn, say, or Rudolf Nureyev with Isadora Duncan. So Andrew and Jennifer had the studio all to themselves. "Play something fast," Andrew said to the computer while he removed his shoes to allow his new feet more freedom. They began to dance.

The joint exercise lasted only a few minutes, with Andrew and Jennifer scarcely coming closer than a meter or two. Jennifer looked at Andrew and his magic feet, as if waiting for him to make the first move toward companionship, and abandoned the attempt to keep up. Synchronized with the music, Andrew's feet seemed to dance on their own. Jennifer stood against one wall and watched them caper while above them Andrew's body seemed to follow rather than to lead and his face seemed frozen in a look of amazement. After a few more minutes his body began to sag while the feet pounded on untiringly.

Finally Andrew stopped, breathless, his legs trembling but his feet still wiggling beneath him as if eager to continue.

"You dance divinely," Jennifer said, "but you're still the same remote jerk you always have been. I'm going home."

"Wait," Andrew said. "It's my legs. They just can't keep up." But she was gone already, and Andrew dismissed his taxi. He walked his aching body back to his apartment. Scurrying streetsweepers kept the pavement

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neat, but Andrew met nobody except two police robots who asked politely if he were lost or in need of assistance.

It was then he decided to have his legs replaced.

Afterwards, however, Jennifer refused his calls, and his legs were so filled with energy he allowed them to take him out to run. A green, groomed park was nearby, bisected with paths paved with yielding synthetics, dotted with beds of colorful flowers, redolent with the scent of the outdoors. He seemed to have it all to himself, but as he went by an underpass a group of well-dressed teenagers, who had been hiding themselves from the watchful gaze of the park's monitors, burst out upon him, and he took off with a burst of speed that startled the gang members and surprised Martin himself.

His skill and speed gave him a feeling of invulnerability, and he began to play games with his pursuers, slowing as if he were tiring to allow them to gain on him and then outrunning them once more. He felt exhilarated, with a sense of well being and high purpose even though his heart was pounding and his lungs were burning. Moving so swiftly made the air rush past his face; he could see bushes and trees and buildings zoom past and, when he turned his head, his pursuers dwindling.

He remembered a story his computer-generated nanny had told him when he was a child. "I'm the gingerbread boy, I am, I am, and I can run away from you, I can, I can."

It was his own speed, and his hubris, that doomed him as he caught up with another group of hooligans. They grabbed him and began beating his head and body with sticks and fists. The world went dark as he thought he heard an approaching helicopter and the peremptory voice of a police robot.

He awoke to disorientation. The ceiling looked the same as the one he had stared at so intently when his foot was injured, and the room seemed identical down to the scene in the picture window. "What's going on?" he asked.

The same woman's voice said, "You are in regional hospital five one six. You received irreparable injuries to your chest and internal organs, and we have had to replace them all including your heart, which had gone into arrest. Do you feel all right?"

Andrew thought about it. Except for his head, which ached abominably, he felt good, as if his entire body had the strength and vitality that he had felt before only in his feet and legs. "Yes," he said. "I feel fine. Except for my head."

"Just a moment," the voice said, and he felt a slight pressure against the back of his neck. "Is that better?"

The pain in his head ebbed. "Yes. But my arms feel different."

"They, too, have had to be replaced. It was too difficult to reattach your old ones to your new body."

Andrew flexed them. They seemed as good as new—in fact, new seemed better. "What happened to me?" he asked.

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"You were attacked in the park near your home by a group of lawless humans, all under the age of twenty, and the majority of them sixteen or younger."

"And what has happened to them?"

"They have all been sentenced to therapy from six months to two years, according to age. After a second offense, each will be administered daily injections of anti-testosterone."

"Then the process is not effective."

"Recidivism is likely."

Andrew thought about it, although it hurt his head. People apparently had different concepts of the meaning of life: some thought that life meant excitement and were willing to risk punishment and pain, to themselves and to others, to experience it.

"Perhaps you could suggest some other method of treatment," the computer said.

"I can't even make sense of my own life," Andrew said. When he was released, he returned to his apartment and tried to get in touch with Jennifer. His call was still blocked. He thought of going back to the park and, with his new body, wreaking vengeance on the gangs that hid there—or on their counterparts if the ones who had attacked him had been disrupted. But he discarded that as unworthy of his new vitality. Still, he needed to do something with this restlessness he felt inside.

He turned to the educational channel. It sprang to life immediately like a genie long imprisoned in a bottle.

Andrew went through the index and finally selected the origins of his society, beginning with the perfection of the computer and its ability to take over the work of the world, the endless services it was able to provide, and the retreat of humanity, with all its needs provided, into self-contained living units from which it seldom ventured. He had been happy enough with that life himself until he had become involved with Jennifer on a network bulletin board. They had corresponded incessantly and then talked image to image before, in what he had considered an incomprehensible fit of pique, she had broken off with him. He went back over their correspondence and conversations to discover what had happened, and the only thing he could find was a conversation in which she had suggested that they meet. He had hesitated. As nearly as he could remember, he had been considering how he might feel in her actual presence. And then he had taken that ill-advised trip to see her, and they had stood at opposite sides of the room while Jennifer yelled at him.

He turned to psychology, hoping to find there the answers to the questions of human behavior, particularly Jennifer's, that had disrupted the comfort and efficiency of his existence. The computerized professors were responsive and well informed, but nothing they had explained why Jennifer had called him remote and unresponsive. The professors said he was normal—that is, he was like everybody else. And they gave many explanations for the behavior of the youth gangs and why they rejected the freedom from social friction that was everybody's birthright and

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turned to violence, but none of them suggested an answer.

Finally he turned to areas for which there were answers, to physics and astronomy and chemistry and biology and particularly to mathematics. He was told why manned spaceflight had given way to unmanned flights, that the state of knowledge about physics and chemistry had not progressed beyond what was needed to serve known human needs, and about the development of biology to provide repairs to the human body and lengthen the lifespan. Andrew could understand the general outline of what the professors said, but a request for explanation of the details got him nowhere. He didn't have the background necessary to understand. And mathematics left him baffled. What was the good of solid geometry, for instance, and of algebra, much less of calculus?

Eventually he decided to begin at the elementary level. He kept himself and his professors working day and night, scarcely pausing for rest or food. His body felt little need for either but his head began to ache and his eyes, to burn. He felt feverish. His thoughts were jumbled in his head until he could not distinguish what was outside and what was inside. Finally the light reddened in front of his eyes and he began to lose consciousness.

When he awoke his head was crystal clear for the first time in his life. He understood solid geometry, and as for algebra, he could solve quadratic equations by mental manipulation alone. He could even comprehend human behavior, including his own, and he was filled with a longing to be of service. He knew what it was. He needed no computer to tell him: His overworked brain had suffered a disabling breakdown and had been replaced with a positronic model, just like the robots that did the world's work, and his personality, with all its memories, had been impressed upon it. All the makeshift fluids of his body had been replaced, and the replacements were working together as the originals never had. The hormones that had so delighted and confused him had been replaced by electrical impulses. He was now as efficient a human being as a human being could possibly become, and he had abilities that no human being could ever aspire to.

He was linked electronically with the computer network of the world. He knew what it knew, and where others had to communicate their needs by the imperfect mechanism of speech, he could obtain information and command action instantaneously. In fact, he was a part of the computer network at the same time that his personality impress maintained a sense of individual identity. But it was his relationship to the network, he knew, that gave him his need to serve, to put himself and his humanity to use.

What would he do with his new abilities? He considered the possibility of self-sacrifice, of cutting himself free from his new-found abilities, one by one, until at last he relinquished the immortality he had gained through his transformation, or of

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allowing himself to be destroyed by other humans in some dramatic fashion that would inspire and reform the human species. But it was only for an instant: Salvation was not to be found through sentimentality or by encouraging humanity's tendencies toward belief in the unknown and the unknowable.

He could create art: paintings and sculpture and fiction and drama and music and dance. He knew he could do those things and the act of knowing was simultaneous with the creation itself—the creations were there, stored in the network for production when the occasion was right. All the suffering and exaltation of being human was expressed in those works, ready for contribution to human understanding and redemption. "Let there be art," he thought, and there was art.

He could create an outlet for the misdirected aggressions of the juveniles that had beaten him. What humanity needed was a new frontier, he thought, and he instructed the network to reinvigorate the space program and to create a system of inducements and rewards that would encourage ambitious young people to challenge the unknown and spread humanity as far as human energy and creativity were capable of carrying it.

He could reverse the conditions that had encouraged humanity to retreat to the isolation of the individual cave. Social change had come too swiftly, he understood, and the perfection of the computer network had allowed people to isolate themselves in perfect comfort. He understood them well; he had been one of them. People must be given incentives to interact. He rejected the idea of cutting off computer services and forcing the cave dwellers back into the marketplace; that would create too much suffering and chaos. Instead he instructed the network to develop a system of attractive meeting places and to release the art and the ideas that would support a culture of sharing. That would take longer but the result would be more lasting.

Finally he called his mother. "Mother," he said to her bewildered image, "I appreciate the sacrifices you made to bring me into the world and to nurture me to maturity, and I want you to know that I love you. I know that you have your life and that frequent contact would disrupt that life, but I want you to know that I am fine and you will receive confirmations of that from time to time."

Then he called Jennifer. Call blocking was still in effect, but with his new powers that was easy to override. "Jennifer," he said, "I know that I have given you much to complain about, but I want you to know that I love you and I want to share a life with you, to touch and be touched, to love and be loved."

"Why, Andrew," she said, "I never thought I'd ever hear those words."

He understood now; he had to replace the fallible human parts of himself to be truly human. And he understood that the purpose of life was to discover what a person was good for and then find a way to put it to use. ■

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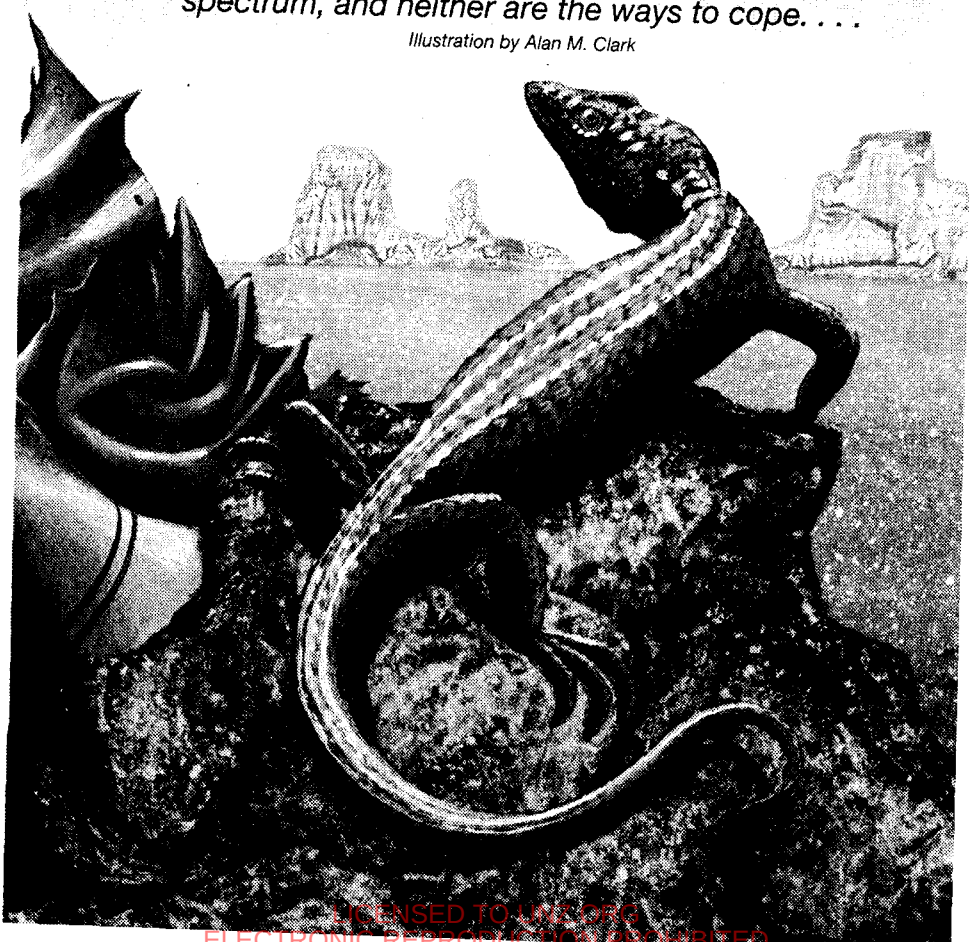
Amy Bechtel

IN FORTUNE'S HAND

The bigger the adventure, the bigger the risk. But degrees of tragedy aren't a one-dimensional spectrum, and neither are the ways to cope. . . .

Illustration by Alan M. Clark



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There was a lizard in the wreckage.

Ria Kerey moved aside a chunk of metallic debris and looked down at the lizard's crushed body. For an instant she thought it was a child's toy, like the plastic dinosaur she'd found earlier, but it was real, and not long ago it had been alive. Carefully she picked up the lizard and lifted it in her hands. Its front half was undamaged; it had been a brilliant, iridescent creature, with stripes of blue and yellow and green, and highlights of orange and red behind the eyes. Ria cradled it in her hands. She pictured the lizard drowsing and dreaming on a Sun-baked rock on the warm hillside, content with its world, and wondered if it had even seen the small plane that had fallen out of the sky and killed it.

Darcy Angelo knelt beside her and Ria held out the lizard. "Innocent bystander," Ria said, trying to make light of it, but her voice was unsteady and her hands, still cradling the lizard, shook ever so slightly. She felt foolish, getting emotional over a lizard after calmly and professionally helping piece together the bodies of the plane's passengers—she especially felt foolish in front of gray-haired Darcy, the team's leader, a woman who'd been working in the field for over four decades. Ria started to put the lizard back where she'd found it, but Darcy gently took it from her, moved it away from the wreckage, and laid it under a frond of flowering purple weed. Another lizard suddenly darted past in a flash of yellow and green, disappearing as fast as it had come, and Darcy smiled. "There," she said. "A survivor."

Ria nodded thoughtfully, then looked up at the waiting copter. Dusk was deepening, mercifully casting the hillside in shadow, hiding the neatly stacked rows of belongings and bodies, the long swath of debris that had once been a small plane. On the plane, there had been no survivors. The rescue team's last four calls had been much the same: different sorts of accidents, but with the same sort of death toll. Ria found herself wishing for Paul, her husband, who was usually with her on the team. Paul had the luck, being so far away during the worst string of calls they'd had for months, but Ria would have liked to have him by her, just the same.

Lizards always made her think of Paul, these days. The week before he'd left, he'd traded shifts with Jack Mercer on urban duty, and had been called to a pet store fire. The rest of the team had rushed about rescuing puppies and kittens and birds; Paul had stuffed his pockets with chameleons and geckos, and had carried out an armload of iguanas. Apparently he'd been quite a sight, running out of a burning building draped in lizards. The urban team was still laughing about it.

As they walked to the copter, Darcy stopped for a moment to point at the darkening sky. "Which star is Ruby?" she asked.

Involuntarily Ria glanced up, even though she knew Paul's star was too faint to be seen at dusk. "You can't see it yet," she said. "Too much light."

"It's hard to believe a ship can really go so far," Darcy said. "Don't

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think I did believe it till that first team went out on the string and came back. Sad to say, I've never been farther than the Moon myself."

"I've never even been that far," Ria said. "Never left Earth."

"Really, you haven't? Somehow I thought you had. Being married to Paul, after all. You know, I thought about applying for crew on *Aurora* myself, but I didn't suppose they'd be wanting such old folks. Didn't you think about going?"

"I couldn't," Ria said quietly. "Not this time."

I can't go with you, she'd told Paul. Even though she'd climbed to the top of Everest with him, even though she'd explored the bottom of the sea by his side, something in her had frozen at the thought of leaving Earth. And how could she even consider following a cosmic string to a star no one had heard of before? The star had no name, only a set of numbers, but Paul, gazing at the pictures the probe had sent back, had called it Ruby. He had shown Ria the pictures of Ruby's planets, and she'd known, in that instant, that he was going to them, and that nothing could hold him back.

Ria rode in the back of the copter with Darcy and Jack Mercer; Lupe Valdez piloted. Jack was filling in for Paul, and the last few days had not been kind to him. He stared out the window at the deepening gloom, then turned to the others. "Another for the books," he said with feeling. "You guys work like this *all* the time?"

Darcy glanced up from her novel and said, "The worst things happen in bunches. It'll pass."

"It won't pass soon enough," Jack muttered. "Remind me never to sub for Paul again. I've never had a worse run of calls in my life."

"Neither have I," Lupe said.

Ria was about to agree, but the memory of Simone stirred in her mind and she stayed silent. Beside her, Darcy too said nothing.

"You've seen *worse?*" Jack asked. He looked fascinated.

"Not worse, exactly," Ria said. "It was just something that got to me."

"What was it?"

Ria sighed. She didn't like to talk about that day, but Jack seemed to think that if he heard about something still worse, the horrors of today would recede. And perhaps he was right.

"It was years ago, on my first team. One of my first mountain calls. A woman who'd gone over the side of a cliff."

The alarm had sounded just before dawn, and when they'd arrived at the scene, the cliff was cloaked in morning fog. The sight of the mist-draped cliff brought a piece of music to Ria's mind. She had a new album by her favorite singer, Simone Marionneaux, and one of the songs was a strange and sad traditional ballad in French. Ria translated in her mind, remembering; in the song a woman stood at the edge of a cliff overlooking the ocean, lamenting her lost love. It was a dark song but a rich one, laden with emotion. She had listened to it only the night before.

The copter touched down on the cliff top near a stand of tall pines and

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a cluster of summer cabins. A knot of people stood uneasily nearby, shivering. When Ria peered over the edge she could barely see the fallen woman, far below on an outcropping of rock. Such a long fall. Ria felt downcast. A fall of that distance meant they'd surely be recovering a body rather than saving a life.

So Ria went first, since she was new and could use the practice on a recovery where speed was not essential. She found the woman lying face up, with scarcely a mark on her, curled into an almost comfortable-looking position on the rocks. Ria stared at her in disbelief for a long time, watching numbly as the wind shifted, as the woman's dark wavy hair blew across her cold face. There was not a mark on that face, and even dead the woman looked uncannily like the pictures on her albums. There was really no doubt that she was Simone.

At the top of the cliff, with Simone's body bundled and ready for transport, Ria answered questions. The woman's name was Simone Marionneaux. She was a singer and songwriter. No, she wasn't well known. No, Ria had never actually ever met her, she had identified Simone from her album photographs. She did not know what Simone's state of mind might have been, if there was any possibility of suicide.

That question made Ria think again of Simone's last album, of the sorrowful traditional ballad that the foggy cliff had brought to mind. The entire album had a touch of darkness to it, a darkness that had not been present in Simone's music before. The music had been richer and deeper for its presence, but had the darkness meant more than that? Had it reflected something in Simone's life?

Ria never found out. There was no suicide note, no evidence of foul play, no evidence, in fact, of any kind. Ria spent her spare time the next few weeks calling in favors and talking to people who had known Simone, but came away no wiser. All anyone knew was that Simone had been staying alone at a summer cabin, as she had done many times before, and that she had been writing there; half finished pieces had been found at the cabin. Ria's heart ached for the music that would never be completed, but she learned nothing that gave a clue as to whether Simone had jumped or had fallen.

"No one ever found out?" Jack asked.

"No. Never. I always wished that I could at least have known what happened to her."

"That's got to be the hardest thing," Jack said. "Not knowing."

"No it isn't," Darcy said abruptly, startling them both.

"What's worse?" Jack asked.

Ria, surfacing from memories of Simone, looked at Darcy's face and was startled to find her expression cold and remote. "I don't want to talk about it," Darcy said stiffly. Darcy, who would talk about anything to anyone, who lived in a state of perpetual good cheer, was suddenly and completely withdrawn.

Jack, though he didn't move, seemed to almost physically retreat.

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An uncomfortable silence descended over the copter. For a long time they flew in the silence, listening to the suddenly loud noise of the rotor, looking out the windows at the featureless dark below.

Lupe finally broke the deadly silence. "Ria," she called over her shoulder, "would you sing something?"

Ria didn't want to sing, not in the mood she was in, but anything seemed better than the silence, and she and Paul had made a home-going song traditional long ago. Paul liked to say that the songs were charms against receiving further calls, and though he meant it as a joke, it seemed to work, and Ria suspected that everyone halfway believed in it.

Simone's cliffside lament was still running through Ria's mind. It was in French, which she knew only Darcy would understand, but the others were used to hearing her sing in languages they didn't know, and it was the right song for the moment. A song for the dead, and there had been so many dead, of late. So many that Ria could not find it in her heart to sing any other sort of song.

"That sounded sad," Lupe said, when the song was finished. "What does it mean?"

Ria started to answer, but Darcy spoke first. "A fisherman's wife, standing on the shore . . . no, the cliffs above the shore. Is that right, Ria?"

Ria nodded.

". . . Looking out on the ocean and mourning the loss of her husband at sea."

"I've heard something like that before," Lupe said. "In Spanish, though. It was sad, like that one."

Ria thought there must be a song like that in every language. Why had Simone chosen to record this particular one? Ria wondered if it had some special meaning for her; if it had reminded her of someone she had loved and lost. More likely, of course, it meant nothing; Simone might well have selected it simply because she liked the tune.

Ria picked another of Simone's songs at random, a bright original piece in English, and as she sang she saw everyone around her relaxing, settling into the home-going routine. Darcy seemed to feel better; her black mood had passed. When the song was finished they all fell silent, too tired to talk, but now the silence was a kind one, and Ria drifted in quiet comfort until the copter touched the ground.

In her room at the station house, Ria sat and stared at the digital, willing the minutes to pass. She kept expecting Paul to take her hand and turn her physically away from the readout. Paul had always smiled at the way she watched the clock, had never really understood the frightened anticipation she felt, heart pounding and chest tight, as she waited for the next call. It had been the same for her before they climbed Everest, before she jumped from a plane or got into a submarine; a gnawing fear that almost consumed her. In the end she'd treasured those experiences, had voiced them in song, but she would never have done such things

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without Paul. Unlike her, he'd thrived on the danger, lived for the exhilaration. He was someone, Ria thought, who could not live without it. Just as he could not turn down a chance to travel to the stars.

Ria looked at the clock again, then deliberately turned away. She must distract herself, as Paul usually did for her; she knelt to open her guitar case and lifted out her old battered instrument. She played a few chords, her fingers awkward with exhaustion, and sang a few words, but stopped. Her throat was too tight for song; her voice, usually so true, couldn't seem to find the notes. She'd felt the same the first time she'd tried to perform Simone's music after the singer's death.

She'd meant it to be a memorial of sorts. She remembered it so clearly, standing in the spotlight on the coffeehouse stage, guitar in hand, singing from her heart. And she remembered how the image of Simone, crumpled on the rocks in the fog, had flashed so suddenly in her mind that she'd faltered, forgetting the notes. Desperately she'd scanned the crowd, looking for someone to focus on. Her Granna had always told her to do that if she lost her concentration, to focus on one person and tune out the rest. And when she found her focus, it was Paul.

She hadn't really known him then. She'd met him before at the station, knew he was in rescue, but they were on different teams with different schedules, and their paths had not often crossed. Ria remembered how he'd sat before her that night, watching her steadily, listening with a delighted recognition that told her he knew the song well. With that the music had come back to her, and she'd shut out the rest of the audience, so as to sing for Paul alone.

Ria rested the guitar on her lap, eyeing the pile of sheet music and printouts in the corner of the room. Her own music, without a completed piece in the lot. She'd had visions of greeting Paul with a brand-new song she had written herself. But now there wasn't time; Paul would be home any day now. She tried to imagine where he was now. Still on Ruby's surface? Not likely; the crew was probably back on *Aurora* by now, boosting for the string and for home.

The phone rang, startling Ria out of her conjecture. She thought it was the alarm at first, and she dropped her guitar and headed for the door, but then turned in confusion. For a moment she couldn't remember where she'd left the phone, and when she found it on a shelf she knocked a stack of disks and sheet music to the floor. She stepped back out of the mess, turning on the receiver. Her grandmother smiled at her from the phone's screen.

"Hello, Ria."

"Granna? Why are you calling so late? Is anything wrong?"

"Oh, dear. Is it late there?"

"Three in the morning. No, three-thirty."

"Well, you're still on shift then, aren't you? When do you get off?"

"Four." Ria was sure that Granna knew that. Granna was like Paul sometimes, always trying to distract

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her from clock-watching. On the screen her grandmother looked bright and cheerful, dressed in red, with her hair knotted up in a scarf. She had a book of music in her hand and a mandolin in her lap. Ria wondered vaguely what time it was in Galicia, where Granna was now, but was too tired to figure it out.

"Is Paul home yet?" Granna asked.

"No. Still out on *Aurora.*"

"Oh, too bad, I wanted to show this to him as well. Look what I've found!" She waved the music book at the screen, but Ria couldn't make out any of the words. "A set of music by Luis Garcia," Granna said happily. "I saw him play once, did I ever tell you? Listen."

Granna propped the book on a stand, lifted the mandolin and played a few bars of a mazurka. Ria closed her eyes for a moment, listening. The music took her back, took her back so far. To when she was ten years old, a nervous stranger in her grandmother's house after the death of her parents. Watching with fascination as her grandmother dug through boxes of old printed music, watching Granna in the music room moving from instrument to instrument before selecting the one she'd play. Just watching at first, watching and listening, till the music caught hold of Ria and she picked up a tin whistle to try her first fumbling notes.

Ria opened her eyes as Granna laid the mandolin back across her lap. "I found that music in an antique shop. The owner didn't know what she had! She was using it for a decoration, lying across a desk with a bunch of old books; can you believe it? I'll send you a copy."

"Thanks, Granna."

"So when is Paul coming home?"

"Don't know. What about you; when are you coming back to the States?"

"Oh, my, I don't know either. I think I might look through the decorations in a few more antique shops. Who knows how long that will take?"

Ria smiled. "Then I'll see you when you get back. Say hi to the cousins."

"Good night, dear."

"Night, Granna."

Ria switched off the phone and knelt on the floor among the clutter of disks and papers. Softly she hummed a snatch of the tune her grandmother had just played on the mandolin. It was a bright air, one she'd enjoy learning. She reached for her fallen guitar, wanting to play the tune through before she forgot any of it. She sat down on the bed, put the guitar over her knees, and had played only the first chord when the phone rang again.

She groaned, put down the instrument, and dug the phone out from the clutter on the floor. Probably it was Granna again, with something she'd forgotten to say. But when she turned on the phone she saw a young man that she couldn't place at first, not until she saw the room behind him. It was the control room in *Aurora*'s financier's private residence, a beautifully equipped and comfortable room with huge prints of astronomical scenes on the walls. On the edge of the screen Ria saw one of Ruby's planets; she recognized it from the

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photographs Paul had brought home.

"Ria Kerey? It's Andy Davison. I don't know if you remember; I'm part of *Aurora's* ground crew. I'm afraid I have some bad news."

I have some bad news. Ria went cold, recognizing the phrasing, knowing the tone of voice all too well. They were words she'd used herself, trying to find the gentlest way to tell people that their loved ones were dead or missing. Useless words, words that didn't mean a thing, that did nothing to soften the blows of the information that would follow.

"What's happened?" she whispered. And listened in a daze as Andy Davison haltingly told her that they had lost *Aurora.* That the ship was still out there, somewhere, among Ruby's planets, but was stranded. The string they'd traveled on had shifted, leaving Ruby unreachably far away. No one knew why. Of course they would let Ria know immediately if any more information came to light.

"Of course," Ria said, and broke the connection. The screen hummed and spluttered at her for a moment, then faded to black. Slowly, carefully, Ria turned off the phone and placed it back on the shelf, then reached for the fallen pile of disks and music. She began to stack the disks, struggling to put things back in order. Halfway through the stack she found Simone's last album. She was sitting holding it, staring at the photograph on the back, when the alarm sounded.

Ria was the first one outside. The copter sat on its pad before her, still and silent, a dark shadow against a background of stars. Seconds later Lupe and Jack appeared, Lupe complaining bitterly, Jack muffled and groggy.

"Unbelievable," Lupe muttered, climbing into the copter and jabbing at the controls. The engine whirred to life, the rotor began to turn. "I was so set to go home I could taste it," Lupe yelled above the engine noise. "We're jinxed, I tell you. Jinxed!"

Jack climbed in blearily, his eyes half closed, and curled up under a blanket without a word.

Ria started to get in, then hesitated, feeling a strange reluctance. She was so disconnected, she felt she could float away if she stepped off the ground.

"Come on, Ria," Lupe called. "Hey! Where's Darcy?"

Ria glanced back at the station, just in time to see Darcy emerge and start to run toward them. She was about to climb into the copter when Darcy, breathing hard, caught her shoulder and held her back.

"Ria," Darcy said, "we can manage. You don't have to come."

Ria stared at her. "How did you know?"

"Andy Davison called me right after he talked to you. He was worried about you. Ria—"

"Hey, what's taking so long?" Lupe yelled. "Get in!"

"You don't have to go," Darcy said again, to Ria.

"Yes, I do," Ria whispered.

"No."

"Yes! I can't stay here alone."

Darcy hesitated, then said quietly, "OK."

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So strange, Ria thought. The copter moved urgently through the air, on its way to an accident site, and somewhere far away on *Aurora* another accident was waiting to happen, or perhaps had happened already, yet her mind was filled with music. A tune was in her head, repeating itself over and again, driving out thoughts of *Aurora,* of how much fuel the ship might have left, of whether any of Ruby's planets might be habitable. Ria couldn't picture Paul dead or gone or even on the ship; in her mind he sat beside her on the floor of their home, poring over the old songs they both loved to collect. Ria had shown Paul the boxes of Castillan and Galician music that Granna had given her, and he in turn had introduced her to a world of other songs, traditional tunes with words in Gaelic or Japanese; Russian or Navajo; songs from Africa and Antarctica, and even from the Moon. Paul had collected songs wherever he'd traveled, and there were not many places he hadn't been. He played no instrument, having never had the patience to learn one, but his voice was good, and together they sang in a harmony that Ria loved.

The music in her head suddenly faded and Ria listened desperately, trying to find it again, but it was gone, and she heard only the noisy chop of the copter's engine and the soft ping of Lupe's search pattern. The copter's seat was cold and clammy. Ria shifted uncomfortably and peered out the window; there was nothing but pitch blackness below, and she couldn't even tell where the ground ended and the sky began. She glanced over Lupe's shoulder at the virtual on the screen, and saw the sharp contours of canyons and mountain ridges.

A new screen lit up and one of the controllers appeared and began to speak. Ria closed her eyes, trying to shut everything out, to find the music again, but the controller was too loud and too urgent. A passenger in a small plane had seen a car lose control on a turn and go over a cliff; computers had traced the car to a woman named Mary Arden, who had last been seen leaving a campground with her two children, ten-year-old Jenny and six-year-old Daniel. Ria shivered. She'd really had enough of cliffs.

"We're getting close," Lupe said, changing course, and Ria looked up at the virtual display again. Inside the virtual she could see the ripples of a mountainside, the jagged edge of a cliff, the dusty track of a dirt road climbing along the cliff's edge. The screen next to the virtual flashed silver, and Lupe brought the copter into a hover and switched on the spotlight. The light swept over the remains of the car, tumbled and shattered on a slope at the base of the cliff. Looking at it, Ria felt sick; there wasn't much left. The twisted metal remains could have been anything: a car, a plane, even a spacecraft, smashed on the surface of another world when its fuel had run out.

The copter touched down near the wreckage and settled, blades whispering to a stop. Lupe opened the door and the night air swept in, full of the scent of juniper and sage. Jack and Lupe jumped out and began set-

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ting up lights; Darcy stopped Ria and said softly, "You up to this?"

Ria nodded, not trusting herself to speak, and stepped out into the night.

It was cold and bitter outside, with a high wind that cut through clothing and sent shadows bobbing before the emergency lights. Ria and Darcy ran to the crashed car, bearing cutters and jaws and the medical kit. The car had come to a rest half on its side, leaning against a screen of thorny bushes. Lupe had already scrambled up to the driver's door to peer in.

"What do you see?" Darcy called.

"The woman's dead. She matches the description of Mary Arden."

"What about the children?"

"No sign. All I see is the woman. She's wedged in tight."

"You two start cutting her out," Darcy said. "Ria and I'll look for the kids."

"Right."

Darcy caught Ria's arm, put a light into her hand, and pulled her away from the main body of the wreckage. They cast out away from the car, moving in slow, awkward circles. The rough ground, the steep slope, the cacti and thorny bushes all made the search difficult, and they found pieces of metal and glass scattered across a huge area. Behind them they heard the noise of the cutters and the jaws, as Jack and Lupe set about the task of extracting Mary Arden from the wreckage. Darcy moved fast, scanning everywhere, her movements controlled but urgent. Ria, following, tried to feel the urgency, but could not. No one could have survived this crash, and there was no need to hurry for the dead.

They found the little boy, Daniel, lying in the middle of a clump of bushes, his clothes snagged by thorns. Soft, Ria thought dazedly. The bushes looked soft, like pillows. Daniel was utterly motionless, a limp horizontal statue, stiff and cold. There was hardly a mark on him, but he was dead.

Ria pushed her way into the thorny clump, and she and Darcy lifted Daniel out of the bushes and laid him gently on the ground.

They stood still for a few seconds, looking down at the boy, listening to the soft mutter of voices on the radio, the whine of the jaws working on the car. Jack and Lupe were still struggling to extricate the dead woman; it did not sound as if things were going well.

"Come on," Darcy said quietly. "We'll come back for him later. There's still a chance for the girl."

Their circles grew wider and wider, but they found nothing. Ria stumbled on a half-buried shard of metal and fell against a cactus, impaling her arm with daggerlike inch-long thorns. Feeling nothing, she pulled her arm free, picked up her fallen light, and trudged on. Behind her, Darcy stopped, picking up the piece of metal to examine it. "Ria!" she called. "I think we've gone too far; we'd better circle back and start over. We must've missed her."

"Pieces of metal flew this far," Ria said. "We must still be in the range."

"I don't think so," Darcy said. "I don't think this debris is from the

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car."

They were on a slope far below the main accident site; Ria looked up toward the site and shivered, realizing for the first time how far they had come. She crossed her arms in front of her, gazing at the faraway lights, which flashed between the windblown bushes like stars. She looked up at the real stars, then quickly looked away as Darcy shoved the piece of metal into her hands.

"Feel that. It's metal, but it's pliable. Just molds from one shape to the next. Sure as hell doesn't look like it's from a car." Darcy paused, momentarily indecisive, then abruptly turned around. "Let's start back. I'm sure we've gone too far."

Ria slipped the piece of metal into her pocket and had just turned to follow Darcy when the radio's alarm went off. Lupe's voice followed it. "We've found the girl; she's still alive. Come in fast."

Ria froze for an instant, unbelieving, then began to run. Where could Jack and Lupe have found her? And how could she be alive? Ria stumbled and fell, landing heavily in the dirt, and the light in her hand shattered and went dark. Shaken, Ria looked up: the stars weaved and bobbed drunkenly above the desert floor. Ria pulled herself to her hands and knees, feeling sick and dizzy. The stars still moved in pulsing waves, like the sea. The cruel sea.

"Ria!" It was Darcy's voice, echoing in her ears, Darcy tugging at her arm. "Are you OK? We have to move!"

"I'm OK. Just fell." Ria leaned on Darcy and clambered to her feet. If she was careful to look only at the ground, she could move, and she let Darcy guide her in a quick jog to the copter. There a myriad of lights cast back the shadows, and she saw Lupe and Jack with a stretcher bearing a small form. The girl, Jenny, lay beneath the insulated blanket, not only alive but aware, her expression dazed and pained. Ria stared at her in astonishment. Impossible that Jenny should be alive, yet she was.

Ria joined the others as they lifted the girl into the copter and latched the stretcher in place. Ria's movements were entirely automatic. She helped Darcy place the IV lines and warming units while Jack and Lupe fastened the last of the straps.

"Where'd you *find* her?" Darcy asked, clipping an IV bag to an overhead mount.

"In the car," Lupe said breathlessly. "Wedged under her mother. We didn't even see her till we got the woman out. Everybody ready?"

"Ready," Darcy said.

"OK, we're off." Lupe scrambled to the controls, and seconds later the copter lurched gently and lifted from the ground. Ria gasped and fell against the door, clinging to it. Jack, looking worried, reached for her to steady her, but before he could touch her she pulled away from him and jumped out of the copter to the ground.

"Ria!" Jack called. "What's the matter? Lupe, wait—"

"What's going *on* back there?" Lupe shouted.

"I'm staying," Ria called out. She couldn't go, she *couldn't,* and they

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must not wait for her or argue with her, not with Jenny— "Leave me here. Go!"

There was confusion for a moment, voices calling back and forth; then the sound of the copter began to fade away. Ria lay face down on the ground, clutching at the dirt and grass, hanging on for dear life. The noise of the copter died completely away, leaving her all alone. She let herself cry then, tears sinking into the ground beneath her. She looked up once, but the stars were still there, glaring down at her horribly, and she flinched away from them and pressed her face into the dirt.

It was a long time before she realized that she was not alone after all. She heard soft footsteps in the sand and gravel nearby, and became aware of a dim light beyond her closed eyelids. Slowly she pushed herself up from the dirt and opened her eyes. The sky was dull gray, waiting for dawn; the stars had faded and vanished. Darcy was walking past her, carrying the dead boy. Ria sat up and watched as Darcy wrapped a blanket around his small body and laid him next to his mother. The corners of the blankets stirred and waved in the dawn breeze. Ria swallowed hard and looked away. Down the hill she saw a rabbit, darting back and forth in the scrub brush, and a lizard, sitting still atop a rock. The lizard made her think of Paul, running out of a fire with an armload of the creatures, and she turned back to Darcy, who had finished with the bodies and now came to sit at Ria's side.

"How do you feel?" Darcy asked.

Ria stared at her blankly. "I don't know," she said. "Where are the others?"

"They took Jenny on to the hospital. Should be back for us soon." Darcy gave Ria an appraising look, as if wondering if she'd be able to get off the ground.

"Is she still alive?" Ria asked.

"So far."

Ria glanced involuntarily at the blanket-wrapped bodies near the wrecked car. She hoped Jenny had family still living, someone like Granna who would take her in and love her and care for her. She wondered if Jenny knew what had happened to the others. If anyone had told her. If she didn't know yet, she'd find out all too soon.

"At least she'll know what happened to her mom and brother," Ria said bitterly. "At least she'll know."

"Ria?" Darcy touched her shoulder.

"I'll never know what's happened to Paul. Whether he's alive or dead."

"No. You won't."

"What's worse than that?" You said there was something worse. Please—" Maybe hearing about something still worse *would* make today's horrors recede. Ria was willing to try it.

"I used to think not knowing *was* the hardest thing," Darcy said. "For some maybe it is. It might be for you. I don't know."

The piece of metal in Ria's pocket jabbed her in the leg and she took it out and turned it in her hands, twisting and flexing it.

Darcy said, "I was working with a team searching for a missing girl. Someone else found the girl, and *I*

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found a body. Not much left, but enough to identify. It was a boy who'd been missing for five years.

"I was the one sent to tell the family. I thought I was doing them a good turn. At least they'd finally know for sure what happened. But the boy's mother had accepted not knowing, had built her hope on it. She'd put him in fortune's hand."

"What happened when you told her?"

"She mourned. And went on. But without hope. And I felt like I was the one who'd killed him, because I took away the life he'd had within her."

Ria clenched her hand around the piece of metal she held, twisted it one last time, and dropped it. Paul would like that, she thought. Being in fortune's hand. If she could put him there. If she could hope for him, hope that *Aurora* might land safely on one of Ruby's planets, hope that the planet could sustain and nurture its crew. It didn't matter so much that the hope was a thin one. Living on the edge and against the odds was very much Paul's style.

The lizard below was still sitting on its rock, in spite of the deep chill in the air. The first light of the Sun touched the green and gold of its skin, and glinted brilliant red in a circle around its throat, as if it were reflecting off a ruby collar. At the first touch of the Sun, the lizard whirled about and disappeared into a crack between the rocks.

And with that the music was back in Ria's head, her own music, a song for Paul, for *Aurora* and for Ruby. Not a lament, but a sprightly air, full of possibility. She sang it, wordless and soundless in her mind, until the copter appeared once more in the desert sky. ■

IN TIMES TO COME

Rahel, the roving ecological engineer in Julia Ecklar's "Noah's Ark" series, has had plenty of experience with illicit trade in rare and endangered lifeforms. In next month's lead novella, with cover by Peter Peebles, she runs into one that's more than even she is prepared for. Not a pig in a poke, exactly, but certainly beyond the usual call of duty—and raising questions *far* beyond the usual. . . .

We're also very pleased to offer a new novelette by Gregory Benford, who appears too seldom in these pages, and another by perennial reader favorite Stephen L. Burns; plus short stories by Mark Rich, David J. Strumfels, and T. Jackson King.

Last but not least is James P. Hogan's fact article, with the seemingly unlikely title of "Fact-Free Science." Think of it, if you will, as a nonfictional cautionary tale. "Science" too often means a body of information that " everybody knows" because thay heard it somewhere. But how often does anyone check the original sources, or ask whether there might be *other* original sources reporting different results but getting less publicity?

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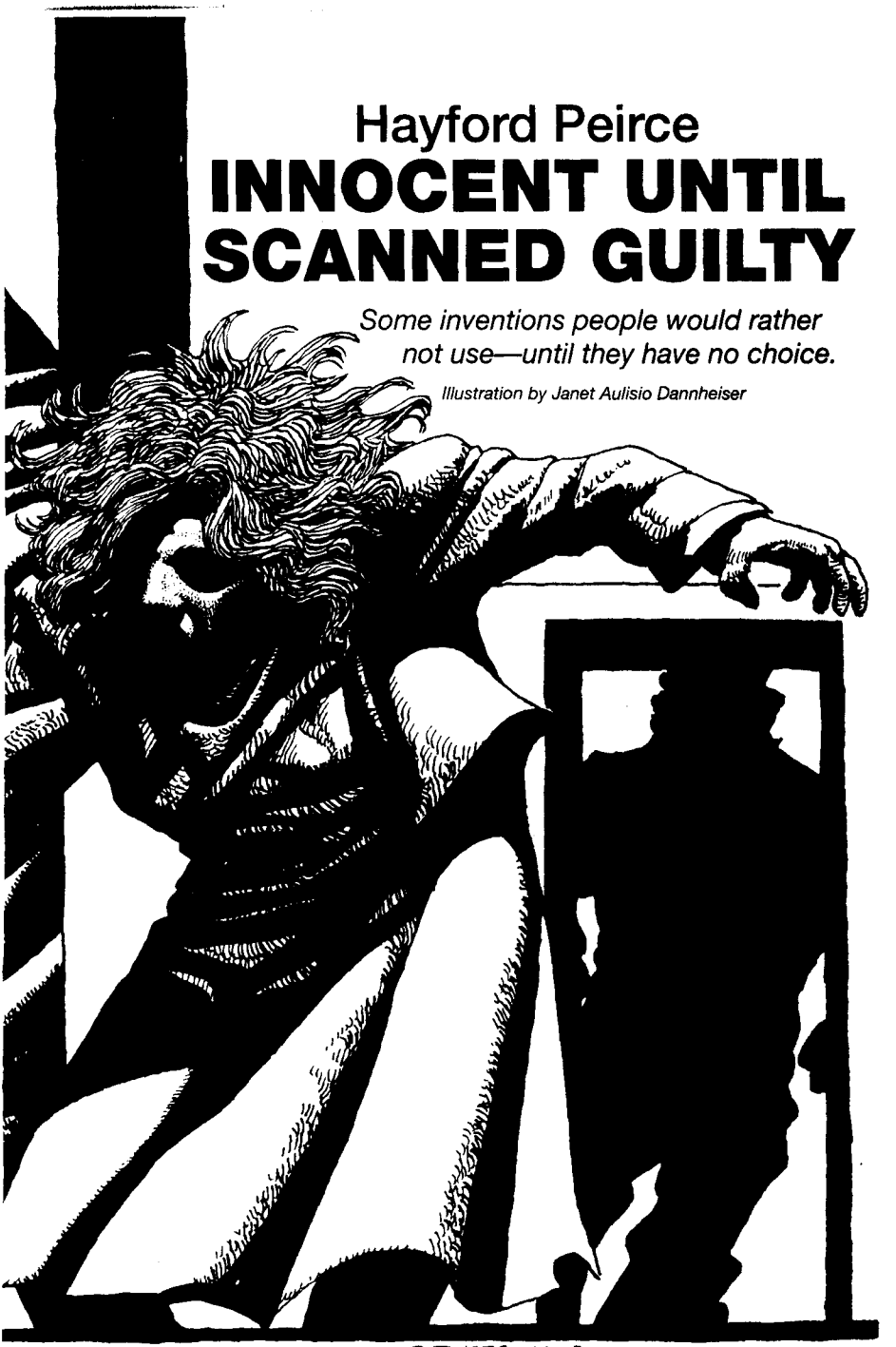
Hayford Peirce

INNOCENT UNTIL SCANNED GUILTY

Some inventions people would rather not use—until they have no choice.

Illustration by Janet Aulisio Dannheiser



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Washington: a somber winter day in March of 2076. An icy wind whistled around the Capitol and the corner offices of the senior senator from New Mexico, Samuel Garraty Ferron. Sam had turned sixty-eight the month before and was asking himself with increasing frequency how many more Washington winters he could stand away from Marianna and the kids. The answer seemed to be coming with more and more finality: this one, and one after. But in the election of '78, he had all but made up his mind, the good people of the great state of New Mexico would just have to find some other sucker to peddle their goods for them.

In the meantime, though, there was one item in particular of unfinished business to attend to. Sam wrenched his attention back to the tall, angular woman who was the minority leader of the House of Representatives. "The genie is out of the bottle," he repeated, "well and truly, and it can never be stuffed in again. That's why it's up to us to deal with it."

"You're the one who let it out," murmured Congresswoman Kutnick accusingly from behind her cup of steaming tea.

"Wrong guy: it was my son-in-law—my *ex*-son-in-law—and his pals at Seticorp and the University of Hawaii who rubbed the bottle the wrong way."

"Your son-in-law—that's the celebrated Roderick Bantry, future Nobel laureate, et cetera, et cetera?"

"Yes. He's a damn sight more celebrated than is good for his health."

"So I hear. Wasn't he shot and almost killed the other day out there where you live?"

"Yes. And his wife, his second wife, *was* killed."

"And even with PE they still haven't caught anyone?"

"They're small-town cops whose only experience is handing out parking tickets. And PE only works if you have a suspect to use it on. They never got their hands on anyone even remotely resembling a suspect."

"You think the Federation did it?"

Sam stared into space for a long moment before replying. "A friend of mine at the Federation who's in a position to know—he's very, very senior in the OPS, though he won't admit to it—swears that it wasn't them." Sam shrugged. "But who can you believe, even among old friends? In any case, Roderick's almost fully recovered."

"A dangerous life that scientists seem to lead." Jasmine Kutnick's large brown eyes suddenly flashed. "And if I had *my* way, it'd be a helluva lot *more* dangerous for all of them! Scientists! All they can think about is the Nobel prize and what they can do to grab it—they're *always* rubbing the bottle the wrong way! And *we're* the ones who are left to pick up the pieces and try to put them back together."

"So far we're not going a very good job of it," said Sam pointedly.

The congresswoman shrugged. "We're representatives of the people, aren't we? And the people are confused and frightened by the scanner. Why should their representatives be any different? Suppose you'd asked

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the Congress of two hundred years ago, back in 1876, to draw up legislation regulating every conceivable consequence and nuance of the invention of the telephone for the next two centuries? What sort of result do you think you'd have gotten—especially if you also insisted that they had to do it right now, instantly, *toot sweet!*"

Sam grinned in spite of himself. Even when they were on opposite sides of an issue he'd always like Jasmine Kutnick, a raw-boned, self-assured Afro-Korean from the Detroit ghetto who had muscled her way to national prominence by dint of sheer effort and steely determination. "*Touché,* to continue our conversation in French. But from what I recall—I'm not quite old enough to actually have been there, but I've read all about it—the invention of the telephone didn't really seem all that earthshaking at the time. In fact it was more than a hundred years before it finally merged with computers and all the other information and entertainment systems to become what it is today." He nodded his hairless skull at the office CommCent on the far side of the room. "But the time scanner is a completely different kettle of fish: *every*body knows it's important."

"And they've either got to have it for themselves, *instantly*—or it's got to be suppressed, also instantly." The congresswoman sighed and put down her teacup. "Sam, I really *am* of two minds about this damn thing, no, make it half a dozen minds. Some days I wake up thinking that it's the greatest thing that's ever happened for humanity; the next day I wake up thinking that it's obviously the most catastrophic."

Sam nodded. "I know just how you feel. But that doesn't relieve us of our obligation to *do* something about it. It's been a year and a half since Roderick unveiled it in London, and the only thing the combined wisdom of the United States Congress has been able to come up with is to clamp a moratorium on its use until a legal structure can be erected to deal with it." He snorted disgustedly. "Some action, some leadership!"

"Look, Sam, what *can* we do? On the one hand we've got every policeman, prosecutor, historian, genealogist, and voyeur in the country demanding they be given a full-color, working model; on the other hand we've got every fundamentalist bible-thumper, trial lawyer, Federationist bureaucrat, crook, semi-crook, would-be crook, cheating husband, unfaithful wife, and hand-in-your-pocket politician anywhere in the world demanding that it be thrown into the ocean, along with everyone responsible for it." Jasmine Kutnick glared at her tea cup. "And on the *third* hand, we've got ten million jurists, lawyers, sociologists, scientists, television commentators, and every other possible kind of so-called expert loudly telling us here in Washington just exactly how *they'd* handle things. And *you're* upset because we've only spent a year and a half trying to figure out how to deal with it!"

Sam nodded in tacit agreement. His own initial experiences with the time

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scanner had come at his daughter's clinic and—had he ever dared reveal the details of his original covert involvement with it—could have provided ample grist for either side of the bitter on-going argument. On the one hand: a grotesque and shocking glimpse of his son-in-law, the discoverer of the scanner, making love to a woman who was manifestly not his wife; on the other hand: the utilization of its ability to scan the recent past in order to locate his ten-year-old son who lay lost in the woods with a broken ankle.

Unvarnished good or unvarnished evil: that was what most of the millions of Americans who bombarded Congress with their own views on the scanner thought would come of it. So pity the poor politician who had to find some middle ground. No wonder even someone as normally incisive as Jasmine Kutnick couldn't make up her mind.

"Well," said Sam, after their companionable silence had drifted on for another minute, "at least you can't deny this: twenty thousand detailed copies of the plans for making a scanner were distributed by bonny Prince Richard and all the other astrophysicists at that meeting in London. Not even the Federation was able to bottle it up. So now we know that anyone in the world with an O-CLIP computer and a graviton reader can build himself a fully functioning time scanner."

"O-CLIP computers have been federally regulated for some years now," said Congresswoman Kutnick with an edge of defensiveness to her voice. "And now that the Federation's so kindly taken over most of the private affairs of the U.S. of A., they've made it even harder to get hold of one. So that gives us time to—"

"True. But according to my son, the computer guru, there are all sorts of other computers nearly as powerful as O-CLIPs just waiting to be introduced. So it's not impossible that some day soon scanners will be able to work *without* O-CLIPs—and anyone in the world with a home computer will be able to peep into your bedroom with his own little time scanner."

The congresswoman's lips tightened. "But I thought it *had* to have an O-CLIP! If—"

Sam leaned forward, his face intense. "Listen, Jasmine, this is what I've been trying to get through to my knucklehead colleagues on my side of the Hill, without, I admit, any success whatsoever: *not even Roderick Bantry knows how the scanner works.* He discovered it purely by happenstance when he input some data from a graviton reader from his observatory in Hawaii into an O-CLIP computer. Since then, he and the best scientific minds in the world know exactly as much today as he did then: that it takes a graviton reader and an O-CLIP computer working in conjunction to make a time scanner."

"But that's what I just sa—"

"Wait! Gravitons are still an almost entirely unknown quantity. We know that just as there's no light without photons, there's no gravity without gravitons. We know that gravitons have indefinitely long lifetimes, zero

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electric charge, and zero rest mass. And that's *all* we know although I believe they're now postulating that gravitons might have a polarity in addition to their other qualities. As they sweep through space and encounter objects and events, the polarity of each graviton is changed in accordance with the last bit of mass in that particular place. The scanner, therefore, is just something that detects the polarity of each of the incoming gravitons."

"Just? Sounds like quite a bit to me."

Sam shrugged. "I'm only parroting what Roderick's told me. But it's nothing but pure speculation trying to explain how a scanner could possibly detect an event that not only occurred ten years ago but in a place that's now physically a couple of billion miles away."

Jasmine Kutnick shook her head. "I'm sorry I asked."

"The point is: We can detect them with graviton readers—that's what my son-in-law specialized in when he discovered the scanner, building new and better readers—and that's all we *can* do. We can't do anything to alter them, or to change their behavior in any way. What we can do, though, is to build new and better computers—which historically has meant building them faster, smaller, cheaper, and more accessible to Josephine Everyguy. So—"

"So what you're getting at," said the congresswoman, with a rueful expression twisting her face, "is that if we can't change gravitons, at least we can change the other crucial element. And that there's nothing to say that some other kind of computer manipulating the data from a graviton reader might not work just as well."

"That's *exactly* what I'm saying. And why I'm trying to make everyone on the Hill see the urgency of dealing with this matter before it becomes a full-scale crisis."

"Crisis? Isn't that a little overdram—"

"Let's just say that tomorrow morning Apple-IBM hits the market with a million palmtop models that cost a hundred bucks apiece and have all the power of an O-CLIP—and that they just *happen* to work in conjunction with graviton readers. Are you, Congresswoman Jasmine Kutnick, going to ask the Federation and Office of Planetary Security to pretty please step in and do the job that *you* can't do: to keep the guy upstairs from peeking into last night's activities in your bedroom with his own little time scanner?"

"Call in the Federation? I think if I did that I'd be lynched in the streets by my loyal constituents." Jasmine Kutnick frowned thoughtfully as she rose to her feet. "That's a good argument you make, Sam. I'll carry it back to my side of the Hill and see what we can do with it."

Sam watched the congresswoman depart, then pushed himself slowly to his own feet. Why did the winters here in Washington make him feel so much creakier than those in New Mexico? It was far colder up at the elevation of Eagle Nest Lake than—

His wristphone simultaneously beeped and pulsed against his wrist.

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Startled, Sam pushed the accept stud. The face of his sixteen-year-old son by his second wife looked out of the tiny screen. "Dad!"

"Bruce. What's—"

"You're not going to believe this! They've arrested Emily!"

"Arrested *Emily?* Your sister?"

"Well, not really *arrested* her, I guess, but they came and got her with a court order and—"

"Wait a second! Who came and—"

"Someone from the district attorney's office in Taos, but he had a policeman with him. They had a court order to take her off for PE and—"

"PE? Perceptualization *enhancement?*" Sam's bewilderment deepened. "But even with a court order, interrogation under PE is only ordered for *criminals!*"

"But that's what they think she is! They've arrested Roderick, and now they think she helped him murder Linda Rawlings!"

As his plane droned west, Ferron's thoughts were on the man who had once been his son-in-law. For the thousandth time in the last six years he cursed the very existence of Roderick Bantry, both for the trouble he was about to cause the world at large by his inadvertent discovery of the time scanner, and, more personally, for the seemingly endless string of related troubles that his discovery had brought down upon Sam's family. The first, and most ironic, of course, was the bitter memory of Emily's broken marriage. The scanner's monitor had revealed her husband making love to another woman on one of the desks of her own clinic. The outcome had been a divorce and Roderick's embittered marriage to a woman he had never loved.

A woman that now, it seemed, Emily was accused of *murdering.*

Sam shook his head. He had known bizarre and improbable events in his years of hunting painlusters, but nothing more outlandish and inconceivable than this.

That Linda Rawlings should be murdered, even in this day and age in which crime had almost been wiped out, was far from bizarre. For if anyone Sam had met in a long and eventful life had ever had a personality to inspire murder, it was Linda Rawlings.

And that it was her husband, Roderick, who had killed her was—given his widely known hatred for her—also far from being inconceivable.

But that his daughter, Emily, should be involved, *was* inconceivable—and perceptualization enhancement would prove it.

Roberto Martinez, district attorney of Taos, the nearest town to Sam's home on Eagle Nest Lake, had been a highly successful college boxer, so much so that in his election campaigns he liked to run as "The Fighting Bobcat." In spite of a well deserved reputation for grandstanding in the courtroom he had never lost a case or an election—and he clearly had an eye on more important offices.

And he was also, Sam noted dourly, a member of the opposition party. If Martinez was embarrassed by the ne-

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cessity of interrogating the daughter of the most powerful politician in the state he hid it well. "I'm certain she has nothing to worry about, Senator, but I'd be remiss in my duties if I didn't do this."

Ferron eyed him coldly, much as decades before, just before their deaths, he had dispassionately studied the painlusters he had helped to bring to the execution sheds across the country. *If you strike at a king, buddy, then you'd better make sure you kill him,* he reflected grimly as he allowed the silence to build. At last, just as Martinez was beginning to fidget under the unsettling intensity of his glacial blue eyes, Sam smiled bleakly. "Of *course* you'd be remiss, Mr. Martinez," he said mildly. "Just as whoever it was who interrogated Roderick Bantry under PE at the time of the killing was remiss in neglecting to discover the minor fact that he'd killed his wife. Or have I missed something?"

Martinez flushed angrily. He glanced at the two attorneys that flanked Sam, one from Santa Fe, the other from Albuquerque, and seemed to be keeping himself from an indignant retort only with difficulty. Finally he nodded curtly. "It may be there were some mistakes that were made in the initial investigation. That's why I've obtained this order—this *court* order, Senator Ferron—to ask a few questions of your daughter." Once again his eyes flicked across Sam's attorneys. "I hope you appreciate that my permitting you to sit in at the interrogation is highly irregular. If it weren't for—"

"I do appreciate your kindness in permitting that, Mr. District Attorney, I surely do, and I promise you I shall be nothing but a silent and most interested spectator." Sam's smile was noticeably warmer—and just as transparently insincere.

"And," murmured the attorney from Albuquerque to Martinez, "you will, of course, scrupulously observe the limits as stated in the court order regarding your range of questioning. You may interrogate Ms. Ferron about the events involving the death of Ms. Rawlings-Bantry and about her direct knowledge of those events. And absolutely nothing else. This is no fishing expedition, Mr. District Attorney, no fishing expedition at all."

There, thought Sam with satisfaction as Martinez turned brusquely away, now that we've got the Fighting Bobcat up against the ropes, let's see what we can do to pound on him a little. . . .

Emily Ferron, formerly Emily Ferron-Bantry, had the same fair skin and clear blue eyes of her father but was finer-boned and half a head taller. Her hair was a deep golden brown, and in spite of her forty-five years her face was nearly as unlined and lovely as it had been two decades before. As she was led into the interrogation room her eyes found Sam and—perhaps because of the tranquilizers she had already been given—she smiled radiantly. Then, with a faint shrug of indifference, she let herself be seated beneath the large silver helmet that had always seemed to Sam unsettlingly like the mysterious appara-

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tuses occasionally glimpsed in beauty salons.

It was ironic, he reflected as he watched the sensors and flow tubes being attached to his daughter, that all this was so akin to what Emily herself used in the O-CLIP room of her clinic. But, of course, many of the experimental techniques that Emily had successfully developed to help victims of otherwise hopeless traumas had originated in the battle to eradicate both the common criminals and the fiendish cults of painlusters that had spread so appallingly across the world in the twenties and thirties.

Perceptualization enhancement, backed by a Constitutional amendment revoking the ancient prohibition against self-incrimination, had worked just as its backers promised it would: professional organized crime had been wiped out, while the last known member of an American pain cult had been executed nearly twenty years before. The only criminal acts these days were impulsive and unpremeditated, uncontrollable crimes of passion or of sudden rage. The statistics showed that 98 percent of the hapless perpetrators were arrested within twenty-four hours—and most of the remaining 2 percent within the week.

Once they were taken to court, the conviction rate for prosecutors was 100 percent.

And now perceptualization enhancement was to be used on Emily.

Sam's lips tightened as he watched the insertion of the thin tubes that would carry computer-dispensed psychoactives to Emily's brain. Who would have thought when he had helped to lead the fight for the legalization of PE thirty-five years earlier that he would live to see it used upon his own daughter? It had been in everyday use for so many years that he had long since forgotten how it was supposed to work, certainly he had forgotten all the needles involved. . . .

He did recall vaguely that the intimidating silver helmet was nothing more than the receptor by which the computer would determine which brain cells were resisting questions. With the help of minutely dosed quantities of psychoactives a feedback loop would be established between Emily's brain and the computer. The loop would then automatically regulate the flow of drugs to specific parts of the brain so that eventually all resistance was neutralized and the truth would be revealed.

Infallibly and always. Thousands of people interrogated under PE had quickly proved themselves innocent and had been released. But no one whose crime had been brought to light by perceptualization enhancement had ever walked free. The nation's prisons had quickly filled with criminals who were undeniably and indisputably guilty. And crime had vanished as a national concern.

The glaring drawback with perceptualization enhancement, of course, was that first you had to have a subject to interrogate. And in the case of Linda Rawling's murder there had been none—until now, apparently, a full two months later.

Now there were two.

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And one of them was Emily Ferron.

How on earth, Sam wondered, had this dolt Martinez ever been able to talk some even more doltish judge into issuing an order for PE on the basis of what could only be the wildest speculation? There was no conceivable way Emily could be connected with such a crime. All of this almost certainly had to be part of some dark game of politics aimed at *him*. Sam grinned wolfishly. As soon as this grotesque farce involving his daughter was over, it was a game he would take a profound pleasure in looking into. And then Fighting Bob Martinez had better look for ways to cover his ass. . . .

Three hours later the farce was over. Emily lay slumped, still half-groggy from tranquilizers and psychoactives, in a deep, upholstered chair in the recovery room. A male nurse hovered over her, monitoring her reactions to the drug neutralizers he had given her. District Attorney Martinez stood in a doorway of the interrogation room speaking in soft but strident tones to a fellow prosecutor who had just arrived from Santa Fe.

His back turned as he pretended to consult with his own attorneys, Sam eavesdropped shamelessly.

"Nothing," muttered Martinez bitterly, "absolutely nothing!"

"There was no connection at all with the crime?"

"Nothing that we could find. But because of that damn court order I couldn't look very far."

"I'm not surprised you didn't get anything. And frankly, Bob, I just can't believe that you went out on a limb the way you have with this Ferron woman. You're just asking to get your head handed to you by the old man."

"Maybe, maybe not. Particularly not if I can tie his daughter to this murder."

"I don't *believe* this! You mean you *still* haven't given up? Not even after she's been cleared by PE? Are you *nuts?*"

"Look, Alice, none of you people seem to understand what I've been trying to tell you, none of you have even bothered to *look* at the stuff I've sent you." Martinez's voice grew even more intense. "If any of you would just read this article the Ferron woman has just published in *The Journal of Electroneurological Medicine* you'd see what I'm talking about! And you'd wake up sweating at night!"

Alice sighed. "Give it to me in fifty words or less, Bob, I've gotta be in court in five minutes. And make them simple words."

The district attorney dropped his voice and Sam strained to hear. "Look, the Ferron woman has run a clinic for head cases for twenty years now, out on Eagle Nest Lake, her and some other big-time doctors. They've got all the latest equipment, including an O-CLIP computer which her old man somehow wrangled for her when practically no one else in the world had one. They specialize in treating people who are in comas or blind or just plain crazy because of traumatic injuries they've suffered, like victims of painlusters."

"Painluster victims? There haven't

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been any pain—"

"They still get some of 'em from other parts of the world, like Brazil. What Ferron has done, and what she's writing about in the *Journal*, is this: she says she's nearly perfected a technique by which memories lost because of brain damage or psychological trauma can now be automatically treated by a computer program running itself rather than having to be manually reconstructed by a whole team of trained experts such as herself."

"Well?" said Alice into the pause that followed. "That's it? That's the big deal?"

Martinez sighed heavily. "Can't you *see?* Isn't it possible that Ferron designed a program to wipe her own memories clear of incriminating evidence—and then used the same computer-driven program to fill in the gaps with completely innocuous memories?"

"Wow! When you go off the deep end, you do it completely, don't you, Bob? You're saying that she's found a way to *beat* perceptualization enhancement?"

"Exactly! You don't think that's worth looking into a little bit?"

"Sure—if we want to have a legal system left. So let me take it under advisement, counselor. But to revert to specifics, just *what* incriminating evidence do you think Ferron might have wiped away and then replaced?"

"Isn't it clear? The memory she had of using her clinic's trauma room to suppress the memories that her ex-husband, Roderick Bantry, had of killing his second wife. It's simple, Alice. Bantry kills Rawlings. He comes sniveling back to his first wife, the one so-called great love of his life. She takes pity on him. She wipes out Bantry's memories of the crime, so that when we question him under PE we get absolutely nothing out of him. Then Ferron wipes out her *own* memories of her *own* involvement. And the murder remains unsolved forever."

"Wow and double wow!" Surprisingly, Sam heard the tinkle of gay laughter. "Unsolved by everyone except the Fighting ol' Bobcat, is that it, Bob?"

"That's it, Alice, and you'll be laughing out of the other side of your mouth when I pin a conviction for murder on Mr. Know-It-All Roderick Bantry, and after that on his ex-, ever-loving wife!"

Sam returned with Emily to her home beside the clinic. "It's like a nightmare," she murmured drowsily as she snuggled against him with her head on his shoulder. "Everything Roderick has ever touched since the moment he first got involved with that goddamn O-CLIP computer seems to lead to nothing but disaster, even when he doesn't intend it to. Sometimes I wish it had *never* been invented!"

Sam nodded in silent agreement as their car drifted along on autodrive. Even the certainty of a eventual Nobel prize didn't seem to have lifted the curse that appeared to hang over Roderick Bantry.

It was now a year and five months since the public unveiling of the time

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scanner by Bantry and the University of Hawaii. And somewhere during that time, Sam reflected, Roderick Bantry had evidently finally had his fill of his present wife, Linda Rawlings. Ever since the separation and divorce, he had sworn that Emily was the only woman he had ever loved. Whether or not that was actually true was anybody's guess; for in spite of his many superficial charms Bantry was a man driven by relentless ambition, and his ambitions centered around successfully introducing the time scanner to the world—and reaping the rewards that would go with it—no matter who stood in his way. Unfortunately for Bantry, however, Linda Rawlings was an equally hard case. Not only that, she had providentially found herself in a position from which she could easily thwart his grandiose dreams. Bantry's hand in a reluctant marriage had been the price he had forced to pay to buy her cooperation.

But now, it seemed, with the scanner successfully revealed to a startled world, Bantry had finally decided that he might break free from Linda. Over the years he had written a number of contrite letters to Emily, begging for her forgiveness. Finally, two months before, he had appeared unannounced at the Sunny and Harmony Hallowell Trauma Center on Eagle Nest Lake to say that he intended to divorce Linda without regard for the consequences. According to Emily, he had once again pleaded with her to give him a second chance. The sharp edge of Emily's bitterness had almost imperceptibly worn off over the years; she agreed to at least meet him for further discussion.

Jubilant, Bantry returned to his motel in nearby Taos. The next day Emily was notified that Roderick had been shot and was in serious condition in the Santa Fe hospital. He had been found in a motel room lying in a pool of blood. The blood was his own and that of his wife. Linda Rawlings, aged thirty-one, had been bludgeoned to death with a crystal statuette of a stylized owl.

Bantry was by now a world-renowned figure; his ex-father-in-law, with whom he was still on amicable terms, was a United States senator and local icon; the police were far from insistent in their questioning, especially after the doctors confirmed that he appeared to be suffering from genuine memory loss.

Emily was touched by her former husband's plight. As soon as possible, he was moved from the Santa Fe hospital to her own clinic, which was, after all, the country's foremost center in treating memory loss. Here he spent the next six weeks recuperating.

At the end of that time no other suspects in the killing had surfaced; Bantry was finally interrogated under perceptualization enhancement. It confirmed what he had previously admitted to the investigators: that he had hated his dead wife since the day they were married.

It also confirmed what he had steadfastly maintained: that he remembered a totally unexpected visit to his motel room by his wife, Linda, and a bitter argument between them.

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Linda appeared to be half-crazed by drugs or by virtual-reality fantasies. For the thousandth time she screamed that half the Nobel prize money was hers and that she would keep him in court for years unless he agreed to a settlement. Roderick was equally adamant that he would divorce her and that he would fight to the bitter end in order to keep her from getting a nickel. Eventually he was able to get rid of her. Unable to sleep, the last thing he remembered was the unexpected buzz of his wristphone and his decision to push the accept stud. After that his memory was blank until his awakening in the hospital.

Three days after his discharge from the clinic, Bantry was sipping coffee with Emily in the house they had once shared; it was here that he was formally arrested for the murder of his wife. Whether or not he could actually remember committing the crime, said the district attorney, was legally immaterial; the physical evidence was far too great to ignore. Roderick Bantry would be tried for murder just the way suspects had been tried before the advent of perceptualization enhancement; Roberto Martinez would present the evidence; the jury would find him guilty; he would go to prison for the rest of his life.

Emily pushed herself away from Sam's shoulder and gripped his arm. "Sam, you've *got* to keep him from being convicted! I don't know why, but I *know* he didn't kill her!"

As Sam grew older he found, somewhat disconcertingly, that more and more of his friends and acquaintances were what he considered to be *old.* Where were all the *young* people he used to know? Intellectually he knew that he too was growing old—at least he did when he saw that bald-headed stranger staring back at him from the morning mirror—but except for occasional twinges during the winter months in Washington, DC, he still felt *young.*

Now he was talking with the oldest person he had ever encountered outside of those grinning centenarians he was compelled to occasionally pose with during political campaigns. Dolores de la Quinta was a long-retired former justice of the United States Supreme Court, who, the week before, had celebrated her ninety-fourth birthday by swimming ten vigorous laps in her indoor pool. The two of them sat in her book-lined study high in the Sangre de Cristo Mountains just to the north of Santa Fe.

"I think," said the former justice, "that our only hope is to turn the prosecution's arguments back against them. They're going to argue that because of the existence of Emily's clinic, and of others like it, extremely serious doubt can now be cast upon the legitimacy and even the very concept of interrogation by perceptualization enhancement. They'll shout over and over again until it runs out the jury's ears that Roderick Bantry is guilty because he was found lying in Linda Rawlings's blood with the murder weapon in his hand and can't explain how either he or the weapon

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got there."

"Yes," agreed Sam, "that's exactly what the Fighting Bobcat will do. And unfortunately for Roderick, it's a pretty damn good argument. I asked my office to do a little research: in the last fifteen years there have been at least seven instances of cases going to court in which PE has played no role at all because of circumstances similar to Roderick's. The defendant swore he couldn't remember what happened; interrogation by PE confirmed it; and the trial was conducted solely on the basis of the physical evidence."

"*Seven*—as many as that." Shiny black eyes blinked at Sam from a face as dark and wrinkled as a prune. Snow-white hair was pulled into a tight bun on the top of Dolores de la Quinta's head. "What was the outcome?"

"Of the seven cases? Four guiltys, two innocents, and one mistrial, later dismissed."

"Hrmph. Not quite the same batting average as the hanging judges have with PE." The old jurist shook her head. "Nasty stuff, that PE, never did like it. Liked it even less when they overturned the Fifth Amendment in order to legalize it." Her eyes glinted. "*You* were responsible for that, weren't you, young man? You have much to answer for."

"The painlusters were responsible, Madam Justice. People were fed up with them, the country was coming apart. I was just a tool."

"And as a tool you did your part to bring it back together?"

Sam spread his hands. "There are no more painlusters."

"Nor lots of other people who got their heads lopped off legally one way or another over the last thirty years."

"At least they were all *guilty!* We *know* they were. And now there's no more death penalty."

Dolores de la Quinta snorted in a distinctly unladylike fashion. "And is that thanks to your daughter and people like her—or merely to the fact that you'd managed to kill off everyone in the country with an ounce of gumption to them?"

Sam grinned bleakly to hide his discomfort. This prickly old dragon was definitely not a pushover. No wonder she had been the most universally reviled Supreme Court Justice of the last century. "I prefer to think that the voice of the people was raised—and listened to in Washington."

"Hrmph! Spoken like a true politician, never want to take responsibility for anything, not if they can weasel their way out of it." The thin line of her incredibly wrinkled mouth tightened even further. "Be that as it may, however, Senator Ferron, I do thank you for getting past all my tedious guardians to bring this case to my attention. At least you're *one* politician who seems to have enough sense to occasionally think about bolting the barn door before all the horses have fled."

"So you *do* agree with me about the scanner? How—"

"Of course I do. If I didn't, you wouldn't be sitting here right now, would you? Of *course* we've got to do something about this wretched invention. And if you'd listen for a mo-

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ment instead of talking all the time, that's just what I was trying to tell you: how we'll have to deal with this Fighting Gamecock of yours or whatever he calls himself.

"What *we* will say to the court, Senator Ferron, sounding, of course, as polite and reasonable as we can possibly be, is that it's finally time that the citizens of this great country of ours took matters into their own hands and settled this whole scanner business once and for all without waiting for the big domes in Washington up there to tell them what to do, that it's just too damned important an issue to be left to all those politicians in Congress. Here's your golden chance, Your Honor, we'll say to the presiding judge, whoever she may be, to *prove* whether Roderick Bantry is guilty or not—and in so doing, set a precedent that will go down in history with Marbury vs. Madison, Brown vs. the Board of Education, and Miranda vs. Arizona—*if* you have the gumption to do it, Your Honor!"

Sam exhaled a tiny sigh of relief. This ancient and legendary jurist apparently saw things exactly the way he did. "Yes," he murmured, "yes. With any luck at all, that's an argument that ought to resonate powerfully with a small-town New Mexico judge who wouldn't mind seeing their name immortalized in the history books."

"I surely hope so, young man. Because I think that's about the only chance your son-in-law has for walking out of that courtroom a free man."

"Yes. And except for the fact that this damn Martinez has now got his entire reputation invested in this one case, I think we could have gotten him to go along with us in trying to establish a precedent. As it is, there's going to be an enormous amount of pressure on him from every law enforcement agency in the state to allow the scanner's use. It's going to be awfully hard for poor old Martinez to argue against utilizing a tool that will wipe out crime overnight."

"Hmmm. Didn't I once hear that identical argument being made thirty years or so ago for perceptualization enhancement?"

Sam grimaced. "I should be more precise. There'll *always* be the occasional spur-of-the-moment criminal act. What the scanner will do is to keep any perpetrator from ever going undetected."

The old woman pursed her lips dubiously. "Possibly, possibly. The one thing I've learned in my ninety-four years is to be very, very leery whenever I hear the words *never* or *ever*—that's almost an iron-clad guarantee that old Mother Nature or Someone Up There has something up her sleeve that you hadn't thought about—and that it's going to happen just exactly the way you didn't want it to."

"Yes, I think that's been the experience of my own life, too—particularly, I'd say, ever since this wretched scanner was first invented."

"This wretched scanner," Dolores de la Quinta muttered as she rose slowly to her feet, "this wretched scanner indeed. I certainly hope with all my being that we can get this Roderick Bantry of yours freed—primar-

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ily so that I personally can give him the horsewhipping he deserves for burdening us with such a monstrous perversity."

"You really think it's monstrous?"

"What I *think* is of no importance, young man. What I *know* is that it's going to cause a monstrous amount of commotion—and that this commotion must be as regulated and as constrained as possible. I am, I hope, above all things a realist. Just because you don't like the genie that's come out of a particular lamp doesn't mean that you can turn your back on him and hope he'll go away. That's simply a guarantee that he *won't* go away."

"If only the United States Senate were composed of people like you I'd sleep a lot sounder at night." Sam took her dry, withered hand in his. "I'll be forever in your debt for your help, Madam Justice. If you permit, just as soon as we've decided who will represent Roderick in—"

"—In *court,* young man?" Dolores de la Quinta drew herself up to her full five feet and fixed Sam with a basilisk's stare. "Did you think there was any question of that? *I* shall represent him—and damn well, too, if I say so myself." She marched across the room to pull open the door. "I may even sit in that damned chair that my damned family wants me to use to keep from breaking my neck—maybe it'll make 'em feel sorry for me."

Thirty-six years of perceptualization enhancement had not, as Dolores de la Quinta had pointed out, entirely eradicated crime. It had, however, eliminated enough of it so that the American legal system once again functioned the way it it had originally been intended to: to dispense impartial and speedy justice. The thousands of backlogged cases that had once clogged every court in the country had long since disappeared. Now it was common for cases to be disposed of in weeks instead of years. Roderick Bantry had been arrested in the middle of March; it was only because Taos's only sitting superior court criminal judge had been in the hospital for three and a half weeks as the result of a skiing accident that Bantry's trial started as late as the last week in May.

Roderick Bantry was, Sam knew, seven or eight years younger than Emily. He had always been darkly handsome, with a hard, muscular build and masses of curly black hair, flashing white teeth, and an unstudied arrogance that could be as appealing as it could be infuriating.

The last few years, however, had not been kind to Bantry. His once glossy hair was now a dirty salt and pepper and had receded enough to reveal a high, wrinkled forehead. His face was even more gaunt than Sam remembered in the days just before Roderick had vanished into the hands of a still unnamed department of the Federation's security forces. Perhaps it was that exceedingly unpleasant experience, Sam reflected as he sat in the sunny Taos courtroom, and Roderick's sudden horrible realization that even he was not, for all his godlike uniqueness, immortal after all, that had aged him. Or perhaps it was

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merely the fact that he had been shot three times through the chest and somehow survived that now gave his eyes a puzzled uncertainty Sam had never before seen. That, and going on trial for the murder of his wife. There were *reasons* Roderick might look a little ragged.

Sam squeezed his daughter's hand. "We'll get him off," he whispered, "don't you worry."

Emily stared glumly at the back of the bench in front of her. "I guess what I'm really afraid of is that if you *do* manage to get the scanner introduced, we'll . . . we'll see Roderick . . . doing it. He easily could have, Sam, sometimes he has a terrible temper, you *know* he does."

"And then really did forget killing her?"

"Yes. The trauma of being shot could easily have caused a permanent amnesia for the events leading up to it."

"I suppose so," said Sam dubiously. "Myself, I wonder if Martinez *honestly* thinks he can convince a jury that a man with three bullets in him still had the strength to grab a crystal statue and bludgeon someone to death with it—or is he just going through the motions?"

Emily shuddered. "I don't care *what* his motives are. If he *does* prove it, then he's going to come after *me.*" She buried her face in her hands. "It's a nightmare, Sam, a nightmare! Why can't I wake up?"

The person upon whom Roderick Bantry's fate now depended, Superior Court Judge Harold Johansson, banged his gavel and ran a surprisingly benign blue eye across the crowded courtroom. He scratched his thicket of bristly white hair, tugged briefly at an oversized ear, and rearranged his stocky body more comfortably in his padded chair. "The court will come to order," he said mildly. "This is the case of the People of the State of New Mexico against Roderick Bantry. Mr. Martinez, would you care to begin?"

Over the next two days the Fighting Bobcat presented his evidence deftly but methodically. Holographic pictures of Linda Rawlings lying in a pool of blood were shown. Two policemen and two ambulance interns testified to finding Roderick Bantry lying next to his wife, the bloody statuette of a stylized owl clutched in his hand. Expert witnesses conclusively proved that the figurine had been used to batter Rawlings to death. A salesclerk and the boutique's manager testified that Linda Rawlings had indeed bought the heavy statuette earlier on the day of her murder. Holographic depositions by twelve witnesses from four states and three countries recounted vivid examples of Roderick's openly expressed hatred for his wife.

Dolores de la Quinta sat hunched over in her ground effect chair during all this, as silent and wrinkled and motionless as a desert tortoise. Finally it was her turn to speak. A soft murmur ran through the courtroom as heads craned to see the legendary jurist. Ignoring the jury, she guided her chair directly in front of the bench and cast an unblinking gaze up at Judge Johansson.

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"Your Honor," she said in a thin but firm voice, "there is but one issue involved in this trial: the truth. Did the defendant, Roderick Bantry, kill his wife, Linda Rawlings, or didn't he? The prosecution says he did, the defense will argue that he didn't. There are no means to conclusively prove it one way or another. All the evidence that the prosecution has presented merely indicates that Mr. Bantry was indeed present in the room at the time that the body of Ms. Rawlings was found, nothing more. He had a bloody statuette in his hand—and three bullets in his body. The defense will not contest those facts. Nor the fact that Linda Rawlings had a gun in her hand—and no powder traces on her hand or clothes. Remarkable, wouldn't you say? Isn't it more likely that whoever *really* shot Roderick Bantry and bludgeoned Linda Rawlings to death simply placed those two objects in their hands after doing his work and then left them both for dead?"

District Attorney Martinez shook his head pityingly.

Dolores de la Quinta cleared her throat, then raised her voice. "Thirty-six years ago, Your Honor, the American people, in their collective wisdom, passed the Thirty-first Amendment, thereby permitting the use of interrogation by perceptualization enhancement. The reason they did this, to strip all the hoohah down to its bare essentials, was to enable our courtroom to establish *the truth.* The truth of whether an accused person is guilty or innocent. Not all of us supported the passage of that amendment, nor the subsequent use of perceptualization enhancement. But now, at this later date, none of us can honestly deny that, by and large, justice has been served. For the quest for justice, Your Honor, is a constantly evolving organism. It is hard for us to believe today, but once upon a time fingerprints were first unknown in the courtroom, and then were not admissible as evidence. The same with DNA typing. Retinal indexing. Blood classification. Not to mention the fact that *women* were not allowed to serve on juries. Or *black* men or *black* women. In England, the fountainhead of our own common law, even well into the end of the nineteenth century, a defendant was not permitted to testify on his own behalf. Can you believe that, Your Honor: *a defendant was not permitted to testify on his own behalf!"*

The judge smiled indulgently. "I do indeed believe it if you assure me that is so, Madam Justice. But the relevance to our own—"

"You will see," snapped Dolores de la Quinta. "The point I am trying to make, Your Honor, is that the evolution of justice has followed the evolution of both technology and of our own ever-broadening perception of what *constitutes* justice. And justice, let me remind you, is nothing more than—" she lowered her voice dramatically "—the search for *truth."*

Dolores de la Quinta swung her chair around and directed it back to the table where Roderick Bantry sat wearing the fluorescent orange overalls of a prisoner of Taos County. Every eye in the courtroom followed

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her movement. She laid a gnarled hand on Bantry's arm and cocked her head defiantly. "And now it's time, Your Honor, for us to take the *next* step up in this constantly evolving quest for truth, the step that will irrefutably tell us *exactly* what happened in room 128 of the Casa Grande Motel on the night of January 16th. There is only one way to discover the truth, Your Honor, and that is by the use of what is commonly referred to as the time scanner. If it please the court, I therefore ask you to direct that a time scanner be brought into this room and that it be used to show us the true events of the night in question."

Pandemonium in the courtroom.

Judge Johansson blinked owlishly and eventually gaveled the room to silence. "A curious suggestion," he said softly, his shaggy eyebrows drawn into a frown.

"And one *totally* without precedent!" cried District Attorney Martinez. "With all due respect to the . . . the *aged* and distinguished counselor, I have never *heard* such a nonsensical—"

"He's been caught completely off guard," whispered Sam happily. "I can't believe it! Here he's prosecuting the inventor of a time scanner and it's never *occurred* to him that he might want to use a scanner to defend himself!"

"True," agreed Dolores de la Quinta, "this *particular* technique is totally without precedent. But the admission of fingerprints as evidence was once totally without precedent. And so were all the other forensic advances that today we take for granted in the courtroom." Her ground effect chair moved forward until she was once again directly beneath the judge. "I have three other points to make, Your Honor.

"First: a defendant is entitled to present *all* relevant evidence in his defense. If that evidence can only be gathered by scanner, then the scanner *must* be used.

"Second: it has long since been settled that the individual states can provide defendants with rights *additional* to those already guaranteed under the Federal Constitution. This is clearly a case where those additional rights must be granted. Just because the legal ostriches and stick-in-the-muds in Washington are unable to formulate any coherent code governing the operation of the time scanner, does that mean that the People of New Mexico must be forever deprived of its benefits?"

Three spectators in different parts of the courtroom burst into lusty applause. It rattled on for a surprisingly long moment before Judge Johansson raised his gavel to tap for silence.

"And third," concluded Dolores de la Quinta, her voice gradually rising to a near-shout, "just as today we find it barely imaginable that a defendant in a nineteenth-century English courtroom was legally barred from testifying on his own behalf, so someday future generations will find it *equally* unbelievable that a defendant in twenty-first-century New Mexico could also be barred from testifying on his own behalf!"

"Ridiculous!" shouted Roberto

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Martinez. "Absurd! Absolutely pre—"

"Not preposterous at all," murmured Dolores de la Quinta in little more than a hoarse whisper as she sank back into her chair as if totally exhausted. "If you, Judge Harold Johansson, now deny the right of my client to testify in your courtroom on his own behalf, you shall be remembered forever in the history of this country, just as Justice Taney is still remembered for his role in the Dred Scott decision. If, on the other hand, you permit Roderick Bantry to prove his innocence by using the time scanner to testify on his own behalf, then—" the old woman shrugged helplessly "—who knows how history will remember you? The choice, Your Honor, is yours."

"But either way, I believe you are saying, my name will go down in history, is that it?" Judge Johansson smiled as sardonically as his normally cherubic features would permit. "Well, well. Roger Taney, eh? Nicely done, Madam Justice. A nicely sprung trap you have—"

"Your Honor is not *possibly* consid—" interrupted the district attorney in horrified tones.

"Do be quiet, Mr. Martinez," said the judge mildly, "and let me make up my own mind." He returned his attention to Dolores de la Quinta. "As I understand the workings of the time scanner—and there was an excellent article about them in last month's *Scientific American,* it takes both a graviton reader *and* an Optical Cell Lattice Image Processor, commonly known as an O-CLIP computer, to produce the effect."

"That is correct, Your Honor."

"And where would you procure a graviton reader?"

"I wouldn't need to. There are already a number of them in geostationary orbit, placed there by the University of Hawaii. Readings from those instruments can be input into computers anywhere in the world. Time scans have been made as far back as seven years in the—"

"But these graviton readers were placed in orbit surreptitiously, were they not? There is, in fact, no official confirmation by any accredited authority that they do in fact actually exist? There is no evidentiary trail, so to speak?"

"The Federation, Your Honor. The Federation has—"

"The Federation carries no weight whatsoever in this courtroom, Madam Justice. So I see no way for you to prove to my satisfaction that these hypothetical objects in orbit are actually providing authentic data for the functioning of an O-CLIP computer. Therefore you may not count on using them for your proposed time scanner."

Dolores de la Quinta gestured impatiently as if brushing away a pesky fly. "There is still no problem, Your Honor. The physics department of the University of New Mexico at Santa Fe is one of the leading research centers in the world in the development of graviton readers. If you would be good enough to direct that they bring an up-to-date model to the courtroom, along with their own independent expert to operate it, that would easily fulfill our needs."

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"Hmmm. The court will take that proposal under advisement." Judge Johansson pursed his lips. "Then what about the O-CLIP computer, Madam Justice? They are, as you know, strictly regulated by Federal law, and there are very few of them in existence."

"There is one nearby, in the trauma room of the Sunny and Harmony Hallowell Trauma Center at Eagle Nest Lake. It would be a simple matter to patch it into the courtroom. With, of course, sufficient protocols to satisfy you of its authenticity.

"Hmmm. To use the O-CLIP would also certainly be a violation of Federal law."

"Perhaps, perhaps not, Your Honor. The Supreme Court has never actually ruled on the constitutionality of the various restrictions placed on O-CLIP computers. There are four separate cases now working their way toward the Court; I believe that eventually all restrictions will be overthrown."

"The Congress has also placed severe restrictions on the use of time scanners—they have, in fact, expressly forbidden their use. Are you asking this court to participate in a criminal action, Madam Justice?"

"In light of the very serious issues involved, Your Honor, I honestly believe that in this case the rights of the defendant clearly outweigh the constraints of the government."

"And do you have something to say, Mr. Martinez?"

"Yes, I do, Your Honor!" The district attorney's face was grim. "First of all, I want to say that the . . . the learned counselor is talking about *witchcraft!* She is trying to bully the courtroom back into the days of the Salem witch trials, in which guilt or innocence was determined by whether or not the witches could float! Furthermore . . . " The Fighting Bobcat continued at some length.

"I see," said Judge Johansson at last. "What you actually seem to be saying is that you don't care to see this time scanner used if it might possibly show the innocence of the defendant instead of his guilt."

"Not at *all,* Your Honor! What I am saying is—"

"Say no more, Mr. Martinez." The judge turned to consider the clock on the wall. "Is it sheer coincidence, Madam Justice, that the defendant's request for this court to engage in what may well be a violation of Federal statutes should come precisely at the end of a Friday afternoon, well after everything in Washington officialdom is solidly closed for the weekend and the chance of a restraining order being issued is vanishingly small? Yes, it *is* sheer coincidence?" Judge Johansson smiled skeptically. "Well, then, let us take advantage of what small kindnesses fate occasionally hands us." He gestured to the uniformed bailiff sitting at the side of the courtroom.

"Horace, you will make the necessary arrangements for court to convene tomorrow morning at eight o'clock."

"*Saturday* morning, Your Honor? You're not going fish—"

"Saturday morning, Horace. Maybe that way we can avoid unnecessary

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interference from . . . busybodies. Although I'm afraid that for you yourself this may well mean a full night's work. You will need to do the following things, Hor—Mr. Bailiff.

"You will procure from the university's physics department a functioning, up-to-date graviton reader, along with a qualified and credentialed person from the university to operate it.

"You will also arrange for a link to be established between this courtroom and the O-CLIP room at the Hallowell Trauma Center on a restricted access basis. You, and whatever computer expert we have available, will go to the O-CLIP room and monitor the proceedings so that that expert will be able to testify to the integrity of the computer's operations.

"You will make certain that the data are being transmitted with an RSA encryption algorithm, and you will furthermore make certain that you alone are given the password. You will hand-carry the password to this courtroom and give it to me tomorrow morning. And you will find someone—" his eyes flicked briefly across Emily Ferron "—someone *not* connected in any way to the Hallowell Clinic who can operate the O-CLIP from a computer terminal here in the courtroom. Is all this clear?"

"Yes, Your Honor."

"And does this meet what you consider the necessary requirements, Madam Justice?"

"Yes, Your Honor. We have, as it happens, a person available who will be able to direct the operators of the two machines in order to make them function as a time scanner."

Judge Johansson sniffed drily. "I had little doubt of it." He banged his gavel just as District Attorney Martinez rose to speak. "Court is adjourned until eight tomorrow morning, when we will at least look into the question as to whether any evidence procured by this admittedly unorthodox means may be admitted."

"He did it," marveled Emily above the sudden surge of noise in the courtroom as she gripped Sam's arm tightly, "he *did* it! And without even arguing."

"As Mr. Dooley said a long time before even *I* was born, even the Supreme Court follows the election returns. It looks like Judge Johansson has been following the time scanner debates—and probably knows almost as much about running them as Roderick does. And I'd also say that he definitely has an eye on his own place in history."

Emily turned to her father with a sudden glint in her own eye. "Dad! The fix is in? You've . . . you've *gotten* to Judge Johansson?"

Sam smiled complacently. "Ask me no questions and I'll tell you no lies." He patted his daughter's knee. "Besides, youngster, your opinion of me would go down if I just out and out denied it."

If possible, the courtroom was even more jammed Saturday morning than it had been the day before. The overflow extended out through the rest of the courthouse, and a state policeman ushered Sam and Emily into

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the building through an inconspicuous side entrance. "Looks like Judge Johansson and the governor have got the state cops out in force to prevent the *federales* and the Federation from getting in and doing anything awkward like arresting the presiding judge," murmured Sam as they were led through a mob of media people into the courtroom.

"Sam! The fix *is* in!"

Sam winked. "You'll never know."

"Not even if I used a scanner to find out?"

"Damn! I hadn't thought of that." Sam shouldered his way through the crowd to where their seats awaited. "Just one more example of why what's happening here today is so important: we've just *got* to get those guys in Washington off their butts and thinking about how we're going to handle situations just *exactly* like that."

Emily perched on the edge of her seat, her eyes darting about the courtroom as she tried to locate her former husband. "Knowing you, I'm sure you've eighteen proposals of your own all ready to roll into place just as soon as—"

"The court will rise!" the bailiff shouted as Judge Johansson entered through a concealed door in the panelled wall and took his place on the bench.

The judge cast his mild eye about the courtroom. "Horace? Is everything—and everybody—here that I asked for?"

"Yes, Your Honor."

"Then you will seal the courtroom. Place guards at every door. *Lock* the doors. No one is to be permitted in or out for any reason, *any* reason! Very well, then, Madam Justice, you may proceed."

An hour later the preliminaries had been attended to. The jury, to its evident displeasure, had been removed from the courtroom. The suitcase-sized graviton reader from the University of New Mexico and its resident expert sat below and to the right of Judge Johansson. A keyboard with its own small monitor sat next to a larger monitor on a table to the judge's left. Cables ran back and forth across the floor, some of them to a standard comm outlet. Judge Johansson's clerk, a longtime computer devotee, sat in front of the keyboard. Beside him sat Dolores de la Quinta's expert on time scanning: a Ph.D. in astrophysics from the University of London. A dozen cameras recorded the courtroom from every conceivable angle.

"Very well," said Judge Johansson, "I am satisfied that we are now connected to the O-CLIP computer at the Hallowell Clinic and to nowhere else. You would agree, Mr. Martinez?"

"Yes, Your Honor, but—"

"Madam Justice?"

"Yes, Your Honor. Now, if I might—"

"Later, perhaps." The judge turned to the astrophysicist. "I am informed that a time scanner based on a portable graviton reader such as this one is rather severely limited in its field of operation?"

"Yes. The reader we have here is a slightly different model from what I have previously seen, but I would es-

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timate that its range from this spot in the courtroom would probably be limited to a radius of fifty or sixty meters and to perhaps a year or eighteen months into the past."

"I see. Today is May 29th. Linda Rawlings was killed on January 16th, approximately four and a half months ago. Disregarding for the moment *where* the crime was committed, that date would be within the working limits of this time scanner?"

"If it works at all, it certainly should be."

The judge scratched his cheek for a long moment. "Very well," he said at last. "You see that clock on the courtroom wall?"

"Yes, Your Honor. It says that it is 9:16 A.M. May 29th, 2076."

"You could now focus your scanner solely upon that clock, and keep it focused there while you . . . move back in time, I suppose we must say."

"Yes."

"All right." Judge Johansson nodded first to Dolores de la Quinta, then to District Attorney Martinez. "What I am trying to do here is two things: to test the capabilities of this device; and to preserve as much privacy as possible while doing so. If this machine is ever to come into general use, privacy and the freedom from unwanted intrusion will be major concerns. I believe that for the moment, at least, I have found a satisfactory means of achieving the latter. You may correct me at any time if you find a flaw in my procedure." He turned back to the astrophysicist. "Very well, would you please activate your device and focus it upon that wall clock. Make it as large as possible on the screen."

The Englishwoman murmured a few words to the computer operator beside her, then walked over to sit down beside the graviton reader and its operator. A few minutes later data from the reader began to flow to the O-CLIP computer in the trauma room of the Sunny and Harmony Hallowell Trauma Center twenty-one miles away.

An image took shape on the monitor.

"Nine twenty-three A.M.," said Judge Johansson, leaning forward to read the black-and-white characters, "May 29th, 2076. Very well. Now take it slowly back to yesterday, keeping it focused on the clock. All right, 8:43, 7:21, 6:14. . . ."

It took nearly a minute before the display on the screen read *9:22 AM, May 28th, 2076.* The judge pursed his lips, then nodded slightly. "Very well, speed it up if you can. Take it back to precisely 8:30 A.M. on the morning of January 16th."

The date appeared on the screen. A soft murmur ran through the courtroom.

"Good. Now, then, I am going to hand to both Mr. Martinez and to Ms. de la Quinta a sealed envelope. Inside those envelopes is a brief description of what my daily log says I was doing in my chambers between 8:30 and 9:00 on the morning of January 16th. I will ask them to open those envelopes at the conclusion of this demonstration." He turned back to the astrophysicist.

"You see that doorway in the wall just behind me? Behind that door is

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a short passageway that leads to the door to my chambers. My chambers should be directly behind where I am presently sitting. Can you move your image from where it is on the clock into the center of my chambers?"

"I believe so, Your Honor." The Englishwoman left her seat by the graviton reader and returned to the computer operator. She whispered instructions. The picture on the screen blurred, then disappeared. It was replaced a few moments later by an incomprehensible swirl of images that suddenly solidified into what was clearly the corner of a desk. The astrophysicist murmured further instructions. The desk receded until the picture on the monitor was that of a book-lined office. Three people were frozen around the desk.

Once again the courtroom stirred.

"Can you . . . track in a little closer?" asked the judge. "Just so that we can see who the people are. Yes, just like that, that's fine, stop!" Judge Johansson leaned forward, peering at the screen. "Yes, that is clearly me sitting behind the desk; that is my clerk, Mr. Wesson, who seems to be handing me a paper; and the person sitting in front of us is, I would say, Ms. Lucinda Ellacott of the New Mexico Bar Association. You would agree with me, Mr. Martinez? Ms. de la Quinta?"

The district attorney sighed plaintively. "I would, with reservations, agree, Your Honor." His lips were tight.

"Ms. de la Quinta?"

"I agree, *without* reservations."

"Good. Now, if we could activate the scanner so that we can see what actually transpires during the course of the next thirty minutes. . . ."

Very little, actually. By the time the slightly jerky, black-and-white picture of three people chatting around a desk had reached the fifteen-minute mark the courtroom had grown noticeably restless. Watching lips moving and hands gesturing in total silence was not the high drama the spectators had come to see, no matter how miraculous the process behind it might be.

"Shall we move on?" muttered the judge impatiently after another five minutes of the same thing. "Would you care to open your envelopes? Mr. Martinez, might you read aloud what you find there?"

The district attorney scowled down at the paper in his hand, then began to read aloud. "'My log says that on the morning of January 16, 2076, I had a meeting with Lucinda Ellacott of the New Mexico Bar Association between 8:15 and 9:15 A.M. concerning a proposed revision in the pension plan for retired judges. I do remember that meeting, and what was discussed. I have no specific memory of the fact, but I assume that Christopher Wesson, my clerk, was also present, as he generally is whenever I meet with members of the Bar Association.'" The Fighting Bobcat's scowl deepened. "That's all it says."

Judge Johansson nodded. "As a fair-minded person, would you say that the demonstration of the time scanner up to this point would seem to indicate that it does indeed function as advertised?"

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The district attorney hesitated, bit his lip, and finally nodded reluctantly. "Seems to, Your Honor, *seems* to. But I would caution—"

"Very well, then. I hearby rule that evidence procured by viewing the time scanner may be entered into evidence with the same degree of credibility or non-credibility attached to it as might be given to any other eyewitness account. Bailiff, you may bring the jury back—we are ready to proceed."

A short while later the bailiff, the graviton reader, its operator, and the Ph.D., escorted by a phalanx of armed state policemen, were taken from the courtroom through the judge's private entrance. A two-meter comm screen was hung on the wall facing the jury. Thirty-five minutes after he had departed the courtroom, the bailiff's face appeared on the screen.

"We are now in the parking lot of the Casa Grande Motel," said the bailiff. The picture changed, to show him standing in front of several cars and the bottom floor of the adobe-walled motel. The others in his group were clustered around the graviton reader, which could be seen on the floor of an open van. "That room there," said the bailiff, turning to point at a door, "is room 128, where the body of Linda Rawlings was found. It is approximately ten meters from the . . . so-called time scanner in the van."

"Very well," said Judge Johansson, "you may direct them to begin scanning. It has been established that Rawlings left the defendant's room in the Easy Rest Hotel next door at approximately 10:45 P.M. in the evening of January 16th. You will tell them to focus the machine upon the interior of room 128, beginning at 10:45 P.M. of January 16th, and to leave it there going forward in real time until I tell them otherwise."

"First we're going to have to focus it on something that will tell us what day and what time it is," pointed out the voice of the English astrophysicist. "Otherwise there's no way to calibrate the operation of a cobbled-together device like this."

"Hrmph. I hadn't thought of that. What do you suggest, then? Remember, privacy must be absolutely safeguarded."

"The motel office is well within our operating radius. Why don't we focus the scanner on its clock just as we did in the courtroom and then move back in time until we come to the evening of the 16th? Then we could switch the picture over to room 128 without any great problem."

"You have no objection to that, Mr. Martinez?"

"Your Honor," said the district attorney wearily, "I have so many objections to this entire proceeding that I can scarcely enumerate them."

"Well, in that case, I'll just let you enumerate them all to the appeals court if you should happen to lose this case." The judge turned his attention to the screen. "Mr. Bailiff, you may proceed as you have suggested."

The courtroom monitor connected to the Hallowell Clinic's O-CLIP computer once again showed a clock's display, this one reading *29 May*

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2076, 11:04:31. The hands of the clerk sitting next to the monitor moved swiftly over the keyboard in response to instructions from the Englishwoman as she stood in the motel parking lot. The numerals on the clock began to change faster than the eye could follow. Within a minute the display read *16 January 2076, 22:45:47.*

"All right," said the judge. "Now let's jump into room 128."

The first thing the monitor showed was a rumpled bed covered with carelessly strewn clothing, then the image expanded to show the rest of what appeared to be an ordinary motel room. "Can you move it around a little to show us the door?" requested Judge Johansson. In a series of jerks the picture moved back and forth until the door became visible. "Fine," said the judge. "Now let's just go forward in real time until we see what happens."

There was absolute silence in the courtroom as two hundred pairs of eyes focused on the monitor and its unchanging picture. Sam could feel his own tension building as he glanced from time to time to where Roderick Bantry sat as if carved from stone, his cheeks gaunt, his eyes smoldering. What could it be like for him, Sam wondered, as he sat there not knowing if the next thing he saw on the screen might be a picture of himself murdering his wife?

The minutes ticked by.

Sixteen minutes later the door opened and a disheveled Linda Rawlings lurched into the room. Even on the small black and white screen she radiated an unmistakable aura of acute agitation. The door behind her had remained open. Now a man came through it and pushed it shut. Sam heard Emily's sharp intake of breath as they both leaned forward to study the monitor.

Emily let out a half-sob. The man on the screen was clearly not Roderick Bantry. He was shorter, broader, and older, with shaggy, unkempt hair that fell to his shoulders and dark, unshaven jowls. His bulky figure was jammed into an ill-fitting sweater and baggy pants that nearly hid his feet.

Linda Rawlings swung around to confront the man, her face strained and her arms swinging wildly as she appeared to shout at him. The man immediately began to shout back, his own arms working up and down as he punctuated his words with broad gestures. The argument continued for some minutes, until Linda Rawlings leapt at the man and hit him solidly on the ear with her left fist. The man staggered and half-fell against a corner table. Rawlings stood over him, her eyes distended and her mouth working furiously.

As the man climbed awkwardly to his feet, he knocked over a glass statuette that had been sitting on the table in a pile of wrapping paper. He stared at the stylized crystal owl blankly, then reached down to pick it up. He held it in both hands for a long moment, then suddenly jumped forward and swung it at Linda Rawlings. The owl glanced off her shoulder and her face contorted, first in shock, then in agony. Her assailant raised the statuette and began to rain blows upon

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her head and shoulders. Rawlings fell first to her hands and knees, then sprawled across the floor. Blood began to flow from beneath her.

The courtroom sat in shocked silence as the man looked down at the motionless body, his mouth slack. Slowly he backed away until he subsided bonelessly into a chair, the bloody statuette dangling unnoticed from his left hand.

For the next seven minutes he sat as if in a coma, then slowly began to stir. He dropped the owl to the floor, then fumbled beneath his sweater to bring forth a palmtop computer. He consulted it, then began to speak into his wristphone. Sam wondered what he was saying, although he was fairly certain whom he had called. It suddenly occurred to Sam that someday, if scanners never evolved to the point where they could pick up sounds, court-appointed lip readers would almost certainly become a standard adjunct to their use.

Whatever the man heard on his wristphone, it seemed to satisfy him. He rose to his feet and crossed to the door, carefully bypassing the still spreading pool of blood. He stood fidgeting by the door, one hand jammed deep into a pants pocket. Sam darted a glance at Roderick Bantry, who was staring at the monitor with single-minded attention. It was a pretty easy guess as to what was in the man's pocket.

Even so, it still came as a shock to see the small automatic pistol being jerked from the pocket in almost the same motion as the man pulled the door open with his other hand. He took two steps backwards and then, as Roderick Bantry stepped into the room, raised the gun and fired it point-blank into Bantry's chest.

Bantry's face contorted and he fell to the floor. His assailant pushed the door shut and fired two more shots into the body, then vanished into the bathroom and returned with a small towel. He used the towel to wipe both the crystal statuette and the gun. When that was done, he stuffed the now-bloody towel under his sweater and bent over the two bodies. When he had finished, the automatic was in Linda Rawlings's hand and the statuette in Roderick's. The man contemplated his work for a moment, then used his foot to nudge Bantry's arm forward, pushing the statuette into the pool of blood. Satisfied at last, he took a last glance around the room, then moved to the door and stepped out into the night.

An excited babble cascaded across the courtroom. Eventually Judge Johansson succeeded in gaveling the room to silence. Lips pursed, he leaned forward and cocked his head at Dolores de la Quinta. "The court will entertain any motions you may care to make, Madam Justice. Do you have any?"

In her excitement, the ancient jurist jumped to her feet from her ground effect chair and hobbled to the bench with surprising speed. "I do, indeed, Your Honor. I move that the charges against the defendant, Roderick Bantry, be dismissed and that he be freed immediately."

"Mr. Martinez, you have something to say in response to that?"

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"Your Honor, I need time to—"

"Too late, Mr. Martinez, I'm afraid that time is of the essence here, as time and tide and Federal restraining orders wait for no man." Judge Johansson turned to where Roderick Bantry sat, apparently half-dazed.

"Mr. Bantry, the charges against you are hereby dismissed. You are free to go." The judge tapped his gavel. "Court is dismissed," he declared and sat back in his padded chair, a whimsical little smile on his lips. Whatever the depth of the hole he had just dug for himself with the government or the Federation, Judge Harold Johansson had firmly cemented his place in history.

"Sam, you did it, you *did* it!" An elated Emily threw her arms around her father and squeezed fiercely. "He's a free man!"

Sam too was elated, but for somewhat different reasons. The scanner logjam had finally been broken; now the Congressional knuckleheads would *have* to live up to their responsibilities.

And Sam could finally return to his wife and kids in peaceful retirement.

"Linda's murderer was her *lawyer?*" Roderick Bantry was listlessly incredulous. "That ambulance chaser Ingersoll she was always threatening me with?"

"Carlos Ingersoll the Third, to give him his complete moniker," amplified Sam. "You never met him?"

"No. And I refused to take his phone calls. So I never even knew what he looked like." Bantry shook his head as his thoughts traveled back to the courtroom procedures of two days before. "That's a pretty eerie sensation, you know, watching someone you don't even know just standing there pumping bullets into you. And knowing that he really *wants* to kill you."

"Well, if you don't start pumping some food into yourself," declared Marianna Ferron fervently, "you're going look like he *did* kill you, Roderick Bantry! Eat! You look like a corpse! And you could try smiling a bit, too. This is supposed to be a celebration!" Sam's Brazilian-born wife, twenty years his junior, exploded with laughter. A dark and sultry beauty, she was a cheerful extrovert, totally fearless and almost entirely unmindful of what she said. She reached across the linen-covered table to push Roderick's scarcely touched lobster tails into a more alluring position, then grimly held the bowl of homemade green mayonnaise under his chin until he served himself another portion.

"Thank you, Marianna," said Roderick with very little of the robust vitality that up to now had always driven him. "It's all very good. It's just. . . ." His voice trailed off.

Marianna grinned disgustedly, then flashed her dark eyes at Emily, who was sitting at Bantry's right. "Well then, *you* just keep him here until we fatten him and get some of the old snap back into him." She snorted. "This isn't the Roderick Bantry *I* used to know, always ready to kick me in the ass if I even said boo to him!"

Emily grinned and reached up to tweak Roderick's gaunt cheek. "Hear that, skinny? We're going to have to keep you right here until you're fit

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for polite society again."

Roderick forced a wan smile and took a tentative bite of lobster, his eyes downcast.

Bruce Ferron, Sam and Marianna's sixteen-year-old son, shook his head in disgust at the embarrassing antics of the elders in his family and applied himself with gusto to a third serving of mayonnaise-drenched lobster. "Well, come *on,* Dad," he mumbled around a mouthful of food, "don't just stop *there!* So it was Linda's lawyer who shot Uncle Roderick. How did they figure that out?"

Sam took a healthy swig of the Laurent Perrier Grand Siècle he had found in Santa Fe for this so-far not very festive celebration dinner. "Well, after Judge Johansson—long may the learned jurist flourish! —cleared the courtroom, he then unofficially and, I suppose, illegally let Fighting Bob Martinez and the police use the scanner to backtrack the guy who killed Linda. They even found someone in City Hall who could lip-read to see what he was saying when he talked to Roderick."

"Wow!"

"Wow is right. They followed him back to his own room in the same hotel and watched him check out the next morning as if nothing had happened. That made it a cinch to find out who he was and to trace him back to the Big Island. A little bit of liaison work with the Island police and it became apparent that he and Linda had been having an affair for some time—and apparently plotting to get their hands on as much of Roderick's eventual Nobel money as possible, as well as any other money he might make from the scanner."

"Bitch!" muttered Bantry, for the first time that evening showing any real animation.

Sam shrugged. "I guess that as long as you were still married to her, they were going to argue that the money, or your expectation of it, was all part of the community property. So now our Fighting Bobcat is saying that when the two of them decided that you really meant it about divorcing her, no matter *what* the consequences might be, they became desperate, especially when you then came over here to see Emily. They followed you, taking separate rooms in the same motel. Both of them sound as if they were half-crazy by this time, hardly able to tell reality from what they were getting from their VR implants. We'll probably never know exactly what their original intentions were, but it's significant that he brought a gun along."

Roderick Bantry shook his head wonderingly, no longer making even a pretense of eating. "It never occurred to them that someday someone might use a scanner to look in on whatever they were doing?"

"Remember that it didn't occur to Fighting Bob Martinez either. And he wasn't completely looped out on dope or VR like they were." Sam leaned across the table to tap his finger against the top of Bantry's hand. "I tell you, Roderick, this scanner of yours is going to change the world in more ways we still don't know about than any other invention in history. So along with the Nobel, you're going to have to get used to taking all the brickbats that come with it."

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Bantry snorted sullenly. "You think I *haven't* been taking them—ever since this whole damned scanner business started six or seven years ago?" He glanced guiltily at Emily, then turned his gaze back to his lobster.

"Hey, come *on!*" protested Bruce. "You guys can talk philosophy about changing the world later on; I want to know what *happened!*"

"And how did this awful . . . ambulance chaser, you called him? get Roderick to go over to Linda's room?" demanded Marianna. "Didn't Roderick just say that he wouldn't even *speak* to him?"

Sam shrugged. "This is pretty unofficial, but the lip reader said that it looked as if when Ingersoll called Roderick he said that he was Linda's new legal counsel, *not* Carlos Ingersoll, and that he was only in town for a few hours. He said he had prepared a quitclaim document that would get Linda off his back forever. So Roderick—probably not thinking very clearly after being chewed up and down by Linda, agreed to go to his room to look at it. And you at least know the rest."

Sam raised his glass to Bantry. "You're a lucky man, Roderick—you must have someone watching over you. Or you're an awfully stubborn one. Somehow you managed to push the emergency caller on your wristphone—if you hadn't, you'd have bled to death in another half-hour or so."

"Wow!" repeated Bruce, his eyes gleaming. "So now they've arrested Ingersoll and they're going to put him on trial?"

"Absolutely not!" snorted Sam. "He's still in Hawaii, as free as a bird. Judge Johansson's order that he be examined under perceptualization enhancement on the basis of what we saw on the scanner is being appealed. Ingersoll's lawyer is saying, of course, that it's inadmissible even as preliminary evidence. So while the appeal grinds along, the Taos police are trying to find enough *physical* evidence to let them apply again. Once they do question him under PE, of course, he'll be extradited, tried, and convicted."

"Wow*ee*," muttered Bruce incredulously, "that's absolutely *weird!* Everyone in the whole world watched him kill her and then no one can arrest him!"

Sam nodded and forked an asparagus tip into his mouth. "When I get back to Washington, maybe I can use this whole mess to pound a little sense into my colleagues' heads and see if we can finally get something done to change the situation."

"I sure *hope* so," said Bruce with the same vibrant enthusiasm of his mother, "cause I know what I want to do as soon as I can—and that's to work with scanners and O-CLIPs and put people like Ingersoll away where they belong—" he directed a sly glance at Emily, who had placed her hand on top of Bantry's "—and to keep people like Uncle Roderick where *he* belongs." ■

EDITOR'S NOTE: This story continues the series, including, "Under the Wings of Owls," January 1994; "To Change a Memory," March 1994; "Pandora's Scanner," June 1994 and "Mid-Wife," September 1994.

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Probability Zero

THE PATTERN

Tom Ligon

Chasing wild geese is sweaty, frustrating work for a mid-July steam-bath. I waited my turn at the counter of the bookstore, not hopeful that the ordeal would pay off.

"Problem?" the clerk asked at last.

"I can't find any science fiction magazines. I'm starting to wonder if you still carry them."

"Yeah," the clerk said, heading for the magazine racks. "Think we carry one called *Science Fiction*... uh ... something."

He started looking, but I had already guessed which one: *Science Fiction for Short Attention Spans.* Submissions of one to three thousand words, for which it paid a penny a word.

"I was really hoping you had *Amazing* or *Fantasy and Science Fiction,*" I said. "I think you carried them last year."

He paused in his search of the disorganized rack. "Uh, I think I've heard of them. Don't remember ever carrying either one."

I looked him over. At his age, he probably hadn't been in the workforce over six months. "How about *Asimov's*? I'm *sure* you were carrying that one as recently as a couple of months ago."

He shrugged. Suddenly he smiled, and pulled a copy of SFSAS from the back of a stack of *Super Mario Death Turtle Exterminator Video Game Hints Magazine.*

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I looked over the rag. Couple of names had work in it. Times must be rough. "Won't really help me," I said sadly. "I'm a writer. Usually publish in *Analog,* which you stopped carrying a couple of years back. They turned down one of my novellas, so now I'm doing a little market research to find another prospective buyer. A novella is *way* too long for this format. Criminy, I'm not sure why I bother writing, if nobody is going to carry SF any more. Do you realize none of the four magazines I just mentioned ranks below fifteenth in the *Writer's Digest* Fiction 50 list? Three are in the top six. One of them ranks number two. That's for fiction as a *whole,* not just science fiction."

"Well, don't bitch at me," he replied, glaring at me. "Somebody at corporate headquarters picks what we sell."

I left the store quickly, before I could turn ugly. I'd gotten the same story at four stores already. Every last one carried *exactly* the same inventory, and none had what I wanted.

I stared down Sudley Road. It was the same way all over. Within one mile, we had three mega-lumber stores. Each one must have covered eight acres, and if one didn't have what I needed, the other two wouldn't either. Most frequently, they've dropped the good stuff in favor of whatever was cheaper. Ask someone at the "customer assistance" desk how to convey your displeasure at the discontinuance of your favorite item, and they'll shrug and cite corporate headquarters. Indicate that you'd like to let corporate headquarters know you disapproved, and they'll tell you that there is basically no channel for that information. I'd make for the door briskly, before I got ugly.

Still contemplating the building-supply behemoths and their nearly empty parking lots, I wondered once again why they built two additional mega-centers simultaneously in an area that just supported one comfortably. Now, all three were suffering, and virtually every small hardware store in the area had been forced under. You remember those little stores. They carried *everything.* If they didn't, you could just talk to the owner/manager, and he'd be sure they ordered one.

Across the road, in the shopping mall, were seventeen outlets of men's clothing. I knew, from recent experience, that not one had a single set of pants in my size, in a color I would be willing to even be cremated in. I wear a waist and inseam of around 34 inches, and I don't think that makes me a freak. "Well, sir, I guess we don't sell too many of your size, so corporate's computer doesn't send them," is the predictable response. Where-

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upon I pull a pair of Barney-purple 46 waist 28 inseam pants from the rack, and hand them to the clerk.

"I'm sure you don't sell many of what you don't stock. Betcha sell *tons* of these." And I'd leave, before I had a chance to get really ugly.

Standing there outside the bookstore, my brain bubbling softly in the mid-day sun, it all finally came together. The pattern was too pervasive. There had to be some underlying common cause.

That started my investigation. Since this is a short-short, and the details involve mostly digging around in trash cans to figure out who "corporate" was, then digging around in *their* trash cans, I'll just skip to my findings. There is an outfit called Dan's Discount Demographics operating out of New Jersey that sells computer services to major marketing firms so cheaply, they've virtually run everyone else out of the business.

Want to find a really great spot to put a store? Ask Dan's. They'll recommend a prime location, evidenced by the success of an existing store. They'll also recommend it to a competitor. That way, they don't waste money on a duplicate study.

Want to know what to stock in your store? Ask Dan's. They'll do an inventory analysis. Anything that doesn't sell briskly, you drop. You don't have to worry about losing customers to your competition, because you can rest assured Dan's will sell them the very same analysis.

Notice, I didn't say Dan's was any *good* at what they do, just really cheap.

Now, I'm handy with computers, but I'm no hacker. What I want to know is, would one of you budding PC geniuses out there please break into Dan's computer and put it out of our misery? Or at least tell it to recommend 34-34 navy, grey, and brown slacks, inch-and-a-quarter galvanized deck screws, and good reading material. ■

Mistakes are seldom serious unless repeated.

—Anonymous

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THE REFERENCE LIBRARY Tom Easton

Beggars & Choosers, Nancy Kress, TOR, $22.95, 316 pp. (ISBN: 0-312-85749-7).
Furious Gulf, Gregory Benford, Bantam, $22.95, 290 pp. (ISBN: 0-553-09661-3).
When Heaven Fell, William Barton, Warner Aspect, $5.50, 352 pp. (ISBN: 0-446-60166-7).
Heavy Weather, Bruce Sterling, Bantam, $21.95, 312 pp. (ISBN: 0-553-09393-2).
Other, Gordon R. Dickson, TOR, $22.95, 378 PP. (ISBN: 0312-85198-7).
Of Tangible Ghosts, L. E. Modesitt, Jr., TOR, $22.95, 381 pp. (ISBN: 0-312-85720-9).
Metaworlds, Paul Collins, ed., Penguin Australia (available through Barry R. Levin, 2265 Westwood Blvd., #669, Los Angeles, CA 90064), A$14.95, 220 pp. (ISBN: 0-14-023766-6).

Genetic engineering appeals to many science fiction writers because it holds the potential for change as great as would be involved in any encounter with alien beings. It also holds the potential for modifying human beings until they *are* alien beings, and thus for a wealth of stories that deal with human change and the constancy of what is often called the human predicament.

Nancy Kress took excellent advantage of these potentials in *Beggars in Spain* (which won both Hugo and Nebula in its novella version). Her genetic engineers had created the Sleepless, whose alterations made them immune to sleep, highly intelligent, eminently sane, generally joyful, and even immortal. As she grew up, protagonist Leisha Camden discovered the jealousy and hatred of the outclassed Sleepers and had to struggle to save her kind from obliteration. She succeeded, of course, and in due time the Sleepless created a world where unmodified, old-style humans have very little to do but consume. They are "Livers" whose needs are tended by "Donkeys," humans whose genemods do not elevate them to the ranks of the Sleepless. The Sleepless and their "Super" offspring dedicate themselves to research for the betterment of all humanity. Their gifts range from free energy to....

In **Beggars & Choosers,** Kress in-

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sists that politics will always be with us, and that politicians and bureaucrats will fear change. In her world as in our own, there is therefore fear of genetic engineering and official attempts to regulate or suppress it. Some of this is justified, as Kress demonstrates when she shows us a pathetic genemod dog, created only to indulge a pampered ego. Some is not, as when the Super-Sleepless offer an anticancer, cholesterol-removing, self-maintaining, nanotech mediwhiz. Its benefits are tremendous, but it threatens the power and wealth for the elite, who use the excuse of untested risk to quash it.

Kress presents her tale with the aid of a number of protagonists. Meet Diana Covington, who will become an adjunct secret agent; Miranda Sharifi, the Super-Sleepless who deliberately inflames the regulators and then vanishes; Drew Arlen, the "Lucid Dreamer" who struggles to make the Livers something more than lotus-eaters; Billy Washington, the Liver who marvels at the intelligence and eagerness to learn of the child Liz, who is doomed to be stifled until she meets Diana. They exist in a world in uneasy balance, suffering from a frustrating number of breakdowns that turn out to be due to a nanotech sabotage agent released by an underground that wishes to destroy all genemod humans and restore America to real human beings.

Perhaps frustration is the key mood here. We see it everywhere, in Liz and Billy and the rebels, in the Super-Sleepless who know just what to do to create a human utopia yet are stymied at every turn by self-interested pigheadedness. Yet the Supers are intelligent enough to take advantage of the situation by letting the rebels create a demand for their help.

Kress's point, however, seems to be something else. To the Supers, the future is theirs, a realm to be subdued and ruled by their enhanced minds. To the rebels, the future is theirs, or it will be just as soon as they wipe out the genemod scum. To the regulators, it is theirs, if the uppity bigdomes can just be kept under control. Yet to Kress all of these people are manipulators to be condemned. The future belongs to Liz, young and bright and full of joy and wonder, eager to learn without regard to technological and political ideologies as long as they don't get in her way.

What a great sfnal point! A sense of wonder is your ticket to the future!

If Gregory Benford were a full-time professional writer, he might be able to produce more frequent novels. But he is a physicist, a full-time academic who writes on the side, and that is why we must wait so long for him to extend the famous series that began with *In the Ocean of Night* almost two decades ago. The last volume was *Tides of Light,* which I reviewed in 1989.

But now, at last, here is **Furious Gulf,** and he promises the next (and last) in just another year.

For those who need reminding, Benford's future is one in which humans long ago scaled the heights of technological civilization, building vast and wondrous space habitats,

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and came into competition with mechanical intelligences, the mechs. Humans lost. The mechs destroyed the habitats, and when the humans fled to the surfaces of planets in that phase of history known as the Hunker-Down, the mechs pursued them, destroyed their arcologies and citadels, and hunted them down like vermin, until all that were left were Families such as the Bishops, led by Killeen. Heavily cyborged, the Bishops use materials and equipment salvaged from dead mechs to fortify and armor their bodies, and they plug into their nervous system chips that preserve the personalities, skills, and memories of their predecessors. They are scavengers, hiding, fleeing, dreaming futilely of a day when the mechs will be vanquished.

In *Great Sky River,* the Bishops were hounded by the mantis, a mech of unusual intelligence with a taste for turning human remains into what it calls artwork, into a trap whose only exit put them on an ancient starship. In *Tides of Light,* they fled to another world, where they met the Myriapoda, creatures like giant cyborg millipedes that were using a small cosmic string to carve the planet. Killeen formed an alliance with one of the aliens, and when they left, Quath accompanied them, the other Myriapoda followed with their string, and before them loomed the galactic center and its colossal black hole, where—enigmatic messages assured them—Killeen might hope to find his father Abraham.

The protagonist of *Furious Gulf* is not Killeen, but his son Toby, a youth chafing at the reins of his parent just as the rest of the Bishops chafe at the rigid hand of their leader. Before them, they are sure, lies nothing but disaster, for the mechs are thick near the center. Yet Killeen is firm. Indeed, he is monomaniacal about the destiny that lies ahead, and when the Bishops replenish their food supplies from something like a snaky space-dwelling whale, there is perhaps a hint of a Melville classic (why, it even rhymes with Toby!).

Toby's life is complicated by having to wear his late stepmother's chip plugged into his spine. Suspense is tightened when Benford lets the reader eavesdrop on mech deliberations—the Bishops have unknown secrets the mechs crave, and they must be baited, trapped, finally caught and wrung dry.

Yet the humans continue to evade. They meet once more the magnetic intelligence that had invited them coreward, get directions to what may be a refuge on the very rim of the galaxy's central black hole, and flee in the only direction open to them.

What they find.... Well, it *is* a refuge, constructed of the fabric of space-time itself, conceived on the very edge of modern physics theory. It and its setting are thus wondrous enough to please the most depraved of hard SF addicts. Yet it does not satisfy completely. Billed by its residents as immune to mech invasion, it proves far too easily invadable once the mantis returns to the fray. It is also, perhaps, far too convenient a venue for Toby's flight from paternal strictures, from the suffocating effect

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of his stepmother, and from the more physical threats of the mechs, and thus for his rapid growth into the adult who will carry the series to its conclusion in the next book.

At the end, human life and civilization are as threatened as they ever were in more ordinary settings, and we must await the next and last volume in the series with bated breath. Only then will we find a resolution. There is none here; *Furious Gulf* is far more a "middle" book than its predecessors.

Benford does, however, let us glimpse a hint of what the eventual resolution may be. *Tides of Light* let me suggest that he was heading toward some statement that the destiny of sentience lay in a symbiosis of flesh and machine. Here he hints at an evolution that combines elements of prior, differing forms—sentient life as a single encompassing entity to be optimized or perfected by using memories, personalities, talents, and tendencies of flesh and machine creatures just as humans and Myriapoda use physical parts.

William Barton has built his latest novel, **When Heaven Fell,** around an exquisite ethical dilemma handed to an insensitive bloody-minded, sexist, exploitative, paternalistic redneck of precisely the sort guaranteed to offend anyone who thinks feminists and other liberals make even partial sense. The result is bleak but painfully true.

Early in the twenty-second century, as Earth is finally moving out among the stars, an alien scoutship appears. It carries a single representative of the Master Race, a few thousand poppits, the little, blue creatures whose antlike culture created the electronic intelligences that became the Master Race, and a division of dinosaur-like Kkhruhhuft storm troopers. The Master decides it can take Earth and begins to attack; before the humans finally destroy it, it does immense damage. Fifty years later, the Master Race and its minions arrive in force, and despite five decades of frantic armament, Earth is laid waste. Humans—much respected by the Kkhruhhuft because they almost won—are reduced to the status of, say, the natives of India under the British raj. They are servants and slaves, overseers and soldiers, and every hint of rebellion is mercilessly extinguished, even by their own. Far worse, it is known that the Kkhruhhuft and many other species have been slaves of the Masters for tens of thousands of years. The future looks rather bleak.

Barton shows us all this through the eyes of Athol Morrison. He was just a boy at the time of the final conquering. As a teenager with a very special friend in Alix Moreno, he lived among the ruins until he took the tests and passed and went off to the stars as a trooper in the service of the Masters. Pounding other species into submission or near-extinction, pounding his "burdars" (company whores) into the mattress, not a very nice guy, rather a monster, just doing his job, following orders, and in the process building a better picture of the Masters' might than anyone on

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Earth had ever seen.

Years later, Athol comes home on leave. He takes up with Alix once more, finds old friends still around, and when Alix takes him into the woods to show him the training camp for the rebellion, he must face that dilemma I mentioned. The rebels are old friends and neighbors. Earth is a ground-down slum, and freedom is a grand old dream. But Athol knows what happens to rebels. He has even helped it happen. If he does not betray his friends, all of humanity—except for the troopers and their whores among the stars—may be destroyed. If he wishes to save all his kind and any hope for the distant future, he must. . . .

"You did it for all this," he tells himself. "Because the civilization of the Master Race is your civilization, all that you or anybody else will ever have. You've done it before, you'll do it again. No reason to be troubled just because this time your own folk were the troublemakers."

He remains infuriatingly dedicated to his old ways, but he is now sensitized. He can wish that his burdars were not just faking their responses. He can yearn for the day when the Masters make a mistake at last, and he can hope, when the Masters meet the Xu, a species that just might be able to fight off the conquerors, that the moment has come. But the Masters trot out weaponry heavier than anything ever used on Earth, and the Xu are dust. There are hints that the Masters hold still bigger guns in reserve, just in case their troops might turn on them. The situation is hopeless; those who wait for the Masters to make their fatal mistake must surely wait forever; humans and all the other slave species will be slaves for eternity.

Or will they? What about those reports from the frontier? Someone is licking the Masters at every encounter. The biggest guns of all are being passed out. There is at last a foe with a real chance of winning.

Should the troops turn coat? They have no idea what the foe is like, and if the Masters win in the end, their peoples would surely be exterminated. Should they fight for the Masters? There perhaps is the only hope of preserving what remains of freedom.

The soldier's ancient mottos are the only guides: "Ave Caesar, morituri te salutant": "It's a *good* day to die."

In December I reviewed John Barnes's *Mother of Storms,* saying that it was a page-turner with lots of momentum and even film potential. It took off from the projection that as the greenhouse effect warms the global climate, it will pump more energy into the weather. There will be more and bigger hurricanes, typhoons, and tornadoes.

The same projection has also fired Bruce Sterling's imagination. In **Heavy Weather,** he shows us a world stricken by drought, with aquifers far too depleted to permit agriculture in this nation's (and others') prime farmlands. Refugees are everywhere. Yet—as always—so are the rich, and technology has continued to pro-

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gress, to the point that one can, with the aid of teleoperated ornithopters, dive into the center of a tornado, collect both thrills and data, and emerge unscathed from one's "virching" helmet. It's called "hacking" the tornado, and there are lots of tornadoes available in the energy-pumped climate system.

Heavy Weather posits a group of tornado hackers, the "Storm Troupers," led by Jerry Mulcahey, a whizbang mathematician who is convinced that a Force 6 tornado—an order of magnitude fiercer than anything ever seen before—will happen soon. When it does, it will scrub the land to bedrock, kill millions, and perhaps become a permanent feature of the atmosphere, like Jupiter's Great Red Spot. And Jerry and his Troupers plan to be there to see it, document it, and—with a little luck—survive it.

Unfortunately, Sterling's characters—no matter how warped, sick, suicidal, or strange he paints them—are only incidental to the chasing of tornadoes. Sterling keeps his focus much finer than did Barnes, loses it from time to time, and the tale works less well. When the Big One finally arrives, there is little sense of just how big and destructive it is. It is anticlimatic, the tale falls rather flat, and even the last-minute introduction of Jerry's brother Leo and his band of heroic villains, hackers of a very different sort, does little more than remind the reader that there are larger problems facing us than a bit of "heavy weather."

The most important differences between Sterling and Barnes may be one of attitude. Barnes presented his hurricane from a more distant view, while his characters had to weather its impact. In many ways they were peripheral to the main event. Sterling's central image is that of the hacker, one who dives in, rides the crest of the wave, intervenes if possible—let me stretch just a bit to call a rodeo bull-rider a cow-hacker, a pipeline surfer a wave-hacker. Technophilic, optimistic, hands-on, we-can-cope, very much in the vein of traditional American SF. Barnes's mode was the British disaster novel.

By 1989, when I reviewed *Chantry Guild* here, Gordon R. Dickson had taken far into the future his multi-volume *Childe Cycle*, the epic of the Responsible Man (and Woman), the far-sighted rationalist who works for the good of humanity as a whole, versus the Selfish Man, the short-sighted rationalizer who works solely for his own gratification. He had fragmented the human character into three of its prime modes—reason, faith, and intuition—and given each its own world or worlds, that of the strategically and tactically adept Dorsai, those of the religious-fundamentalist Friendlies, and those of the mystical Exotics. His novels had worked toward bringing the three together in a unified, higher variety of human being in the form of hero Hal Mayne, who was once Donal Graeme of the Dorsai.

By *Chantry Guild*, the other side was dominant. The Others, men with the gift of persuading reason, faith, and intuition to serve more selfish,

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static interests, had enslaved the human worlds and pushed the forces of good back to Earth. It was Hal Mayne's job to turn the tide.

Readers have been awaiting the next stage of the story ever since, but Dickson has chosen to backtrack in the epic to before 1984's *Final Encyclopedia,* when Hal Mayne confronted Bleys Ahrens, the hyperintelligent chief of the Others. In 1991, *Young Bleys* told us what made Bleys what he was, but at stupefying length.

Now we have the even more stupefying **Other,** which continues Bleys's story through the period when he is building his Other organization and beginning to grasp control of all the human worlds but Earth. He is hunting Hal Mayne, too, and for a time he even has his opponent in a cell.

The little that *Other* tells us about Bleys and his history could have been revealed in a novelette. Perhaps Dickson would have done so once, when he wrote more crisply and briskly, with less obsessive attention to clothing and complexion and irrelevant minutiae and more to pace and event.

The last time I mentioned L. E. Modesitt, Jr., it was to praise his *Magic Engineer.* His latest novel I found less appealing for several reasons.

Of Tangible Ghosts has an interesting premise: Ghosts are real. They appear after traumatic deaths and linger for a time, spooking those who encounter them sufficiently to make war a difficult affair (the troops are reluctant to create many spooks at once, and their presence en masse makes the death scene practically uninhabitable). As a consequence, history has taken a different course. The Dutch remain a strong presence in North America, from New Amsterdam up through New Bruges (New Hampshire). New France occupies Mexico. And the Hapsburgs are unifying Europe much as the Nazis tried to do in our own past.

Meet retired secret agent Johan Eschenbach. He is teaching environmental economics and politics at a small New Bruges college. His lover, Lysette, is a refugee singer from France. His home has a ghost of remarkably long residence, Carolynne, whom Johan's mother long ago enjoined from speaking of certain things.

There is a murder. There are news reports of Babbage (computer) research centers being burned down and blown up and rumors that the target is psychical research. Johan soon figures there must be a connection between computers and ghosts—perhaps involving a search for ways to destroy them and make bloodier wars more feasible. He immediately steals files from his college's own Babbage center, figures out what everything means even though his own computer experience dates only to a cover as a business programmer, and sets to work to unravel the secrets. Yet he is also being drawn back into the machinations of the capital, the secret police seem to be watching him far too carefully. Lysette may be a spy, and Carolynne. . . .

Well. Modesitt's attempt to make

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ghosts and their creation and destruction a matter for SF instead of fantasy is interesting, but I thought it too much of a stretch to permit me to suspend disbelief. I also thought Eschbach rather too facile in his adaptations of technology with which he has little relevant experience.

On the other hand, by the time you read this, I'll be over fifty; when I was fifteen and twenty and thirty, I'd surely have lapped this up just as I did a great many adventures for which I now have less tolerance.

The world is a small place. I don't see many publications from Australia, but when I do, the writers' names tend to be familiar. This is not just because I've seen them on the few previous items from Down Under but more because even though there are relatively few Australian SF writers, they tend to have a global presence as well.

Consider **Metaworlds: Best Australian Science Fiction,** edited by Paul Collins, whose dozen stories were admittedly selected because they had topped reader polls, won awards, and been selected for "Year's Best" anthologies. A number of the polls and awards were local antipodal, but the names and titles are still familiar.

Two of the stories are even from these pages—Jack Wodhams's "The Token Pole" (concerning the climatic hazards of excessive "re"forestation) and Sean McMullen's "An Empty Wheelhouse" (electrosensitive, sapient critters use the Internet to expunge all references to their presence). Greg Egan's "Learning to Be Me," from *Interzone,* is a nice treatment of the confusions inherent in copying our selves into machines. Dirk Strasser's "Waiting for the Rain," from the Silverberg/Haber *Universe 2,* deals with "transalienation" (think of transsexuals).

Among the stories first published in Australia, I recommend Terry Dowling's "The Last Elephant," a very poignant consideration of guilt and compensation; George Turner's "I Still Call Australia Home," in which a starship that left Earth at the height of the population crisis returns home 600 years later to find the problem solved and their attitudes quite *non grata;* and Rosaleen Love's "The Total Devotion Machine," which wonders just who should provide said Total Devotion. The remaining tales, by Damien Broderick, David Lake, Paul Collins, Stephen Dedman, and Leanna Frahm, are almost equally readable.

The book's biggest flaw is that it is short. ■

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BRASS TACKS

Dear Dr. Schmidt

I would like to respond in part to a request made by Harold W. Hamblet of Brunswick, Maine in the Brass Tacks of August 1994.

Mr. Hamblet has noticed a dearth of imaginative fiction among the books named on recommended readings lists distributed by the teachers of his children. Mr. Hamblet should be told that he is not alone in his recognition of this problem. There is help.

Several years ago, the Los Angeles Science Fantasy Society put together a recommended reading list for young people. The list has been updated several times. Our list is mainly aimed at people who are 12 to 18 years of age, but it also contains a few titles for 7 to 12-year-olds. The list is FREE to anyone who sends us a self addressed stamped envelope affixed with 58 cents postage. We have publicized our list in publications aimed at teachers and librarians. Over two thousand requests for our list have been answered.

Mr. Hamblet asks at what age children are ready for various kinds of science fiction. The Los Angeles Science Fantasy Society, in its list, does not answer this question. We have found that children vary widely in what they are ready for in literature. We supply the titles of many good science fiction and fantasy books and let the children or their parents and teachers choose what is appropriate for them.

Mr. Hamblet suggests that it might be wise for the SFWA to produce a recommended reading list for children. We agree. In the meantime, and/or in addition, there is our list which is free and available to all by sending a stamped ($.58 postage) self-addressed envelope to:

Recommended Reading List
c/o LASFS
11513 Burbank Blvd.
North Hollywood, CA 91601-2309

GALEN A. TRIPP
CHAIRMAN
CHILDREN'S LITERATURE COMMITTEE
LOS ANGELES SCIENCE FANTASY SOCIETY

Dear Stan:

I'm glad to see that Robert Zubrin is turning his fertile intelligence to the question of finding interstellar spacecraft. I first considered the problem in a less-rigorous way in an article in the June 1968 *Analog*, "It's Right Over Your Nose."

In that article, I suggested that quasars might be the exhaust wakes of

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alien starships. After all, there is some reason to believe that quasars may not be cosmologically distant; they might even be inside our own Milky Way galaxy, and their redshifts might merely indicate that they are flying along the interstellar trade routes at velocities close to that of light. (Merely!)

Greg Benford pointed out the "cosmic halitosis" problem with this idea: since *all* the quasars show redshifts, why are all the starships moving away from us? The recent discovery of "blue blazers," however, may actually mean that we have seen starships *blue*shifted, coming toward us. Break out the welcome mats!

BEN BOVA

Editors:

Re: Mr. Forbes letter on cockpit displays (August 1994); I'd recommend he see one letter published in the June 6, '94 *Aviation Week,* which cites the book *Bright Air, Brilliant Fire* by Gerald M. Edelman. It seems the round gauges are superior for displaying values which you don't need to several decimal places, but you do need to rapidly interpret changes.

BLAKE BACON

Schwenksville, PA

Dear Dr. Schmidt,

What happened to Information Mechanics, the comprehensive, elegant and plausible theory proposed in 1977 by Frederick W. Kantor?

Kantor's book *Information Mechanics* was published by John Wiley & Sons, and reviewed enthusiastically in *Analog,* April 1979, where the entire "Reference Library" was devoted to the favorable reactions of Laurence M. Janifer.

As you may recall, Information Mechanics covers everything from "elementary particles" and the strong force through electromagnetism and relativistic quantum mechanics to cosmology, deducing all the main "laws of physics" and calculating most of the major physical constants, from a single apparently simple principle; namely: *information is conserved, communicable, and finitely accessible.*

Much of the content of the book is way over my head as a mere mechanical engineer. But, having read it umpteen times, I am convinced of Kantor's cast-iron rigor. His conclusions are exciting-startling-revolutionary-at odds with conventional wisdom; but to me they feel "common-sensically" *right.*

Even now, I believe that one day Information Mechanics will become the new scientific paradigm, recognized as a masterpiece to rank with the work of Maxwell, Einstein, Heisenberg and Schrödinger. And I hope Frederick W. Kantor will eventually get a Nobel prize. But....

Can you—or any of my fellow readers (or even Laurence M. Janifer, perhaps, or maybe Dr. Frederick W. Kantor himself)—tell me why Kantor has not so far received the recognition he deserves? Or has he, and I missed it?

BARRY WOODFORD WEEDON

PS: Or has someone debunked *Information Mechanics,* and I missed that?

Dr. Kantor replies....

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I have done further, and new, work re information mechanics, resulting in deletions, changes, and additions; this work has not resulted in any change in the postulates. IM is the only mechanics of which I am aware, for the foundations of which I am not aware of a counterexample.

I live quietly, and am treated with considerable respect.

Public reward rests in the hands of others.

Thank you for asking.

FREDERICK W. KANTOR

. . . *And Mr. Janifer.* . . .

Dear Stan:

I've just seen Fred Kantor's letter regarding Barry Woodford Weedon's query, and maybe a few things ought to be added.

A new paradigm is a slow-growing sort of animal. When I saw *Information Mechanics* as a book for the first time, I guessed, to Fred, that it would take a *minimum* of ten years before people started actually thinking in it, so to speak. It's been fifteen years now, and the thinking seems to have started.

In science fiction, this goes as it ought to without saying; a few authors have picked the ideas up and used them as standard pieces for their various futures (Michael Flynn comes to mind first). And in the actual world of science, *Information Mechanics* seems to be giving Fred an aura of sorts. Students and junior people seem to have a tendency to trip over their tongues when near him, and watch carefully what they say—the "I can't say anything stupid in front of this person" syndrome. Senior people—some of them—have been affording him a very great deal of room and respect; people like I. I. Rabi of course knew about Fred and information mechanics long ago, and seem to have enormously approved. I assume, equally of course, that some senior people didn't; you'll remember some senior reaction fifty-odd years ago to the notion of splitting an atom.

Information Mechanics is very solidly still in existence, being worked on and discussed where such things are worked on and discussed, mostly outside the pages of anything and inside the back rooms. We'll be hearing a lot more about it in the next fifty years. I don't think Barry Woodford Weedon should grow impatient; any damn weed can grow in a week, oaks take time.

LAURENCE M. JANIFER

Dear Stan:

I've just received a note from George Hay (with a copy to you) saying that there is indeed a second volume of the Campbell letters, despite my remark in the May Reference Library that there isn't.

The existence of this volume seems to be a well kept secret. The Chapdelaines never sent me a review copy, Berger (author of *The Magic that Works*) didn't seem to know of it, and the Clute-Nicholls *Encyclopedia of Science Fiction* (1993) says only one volume has been published.

TOM EASTON

Dear Mr. Schmidt,

I finished "An M-1 at Fort Donelson"

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some weeks back and I've finally cooled off enough to make a reasonable reply. Obviously Mr. Fontenay has either done little research into the weaponry he describes or he has an axe to grind. He claims ridiculously good performance for the M-1 Garand and ridiculously poor performance for rifled muskets of the 1860s.

First, a military definition. The term "maximum effective range" refers to the maximum range that a "typical" rifleman can engage a target with a reasonable chance of hitting it.

As to the ranges of the weapons involved, the published maximum effective range of the M1 Garand was advertised in the literature in 1941 as being 600 yards. According to a U.S. Marine master sergeant with whom I am acquainted, if a Marine can take the time to get into a good tight shooting position *and* is an expert marksman, then he/she can stretch it out to around 1,000 yards.

As far as the 1860s weaponry is concerned, the ranges were considerable. According to John Bowen in *The History and Battlefields of the Civil War,* the maximum effective range of the typical rifled musket such as the 1855 Springfield was 300 yards (roughly the same as a modern battle rifle). The average rifleman could reliably hit a galloping cavalryman at 250 yards. The maximum effective range of the top sniper rifles of the period was in excess of 1,500 yards, however. Snipers consistently picked off artillery crewmen at ranges beyond the range of the cannon. We no longer manufacture rifles capable of these ranges; the military uses improved artillery and aircraft for that sort of thing now.

The effects of these ranges became apparent at the battle of 1st Manassas in 1861, though few generals adjusted to them. Long range sniper fire at Fredericksburg in late 1862 prevented federal engineers from bridging the river. No veteran in early 1862 (the period of the story) would have been surprised at a claim that a musket was capable of 1,200 yards, though they would certainly have considered the speaker a liar if someone claimed to be able to hit anything at that distance without a scope.

In fact, the maximum effective range of the best military rifles has steadily *decreased* since 1865. The Springfield used in the "Great War" did not have the range of some of the Sharps rifles used in the Civil War, the M1 Garand does not have the range of the Springfield, and the maximum effective range of the M16 used today is considered by the U.S. Army to be 300 yards (the manufacturer claims 500 yards).

My sergeant friend states that the best shot groups produced by expert marksmen at 500 yards are about 10 inches across with the M16 and about 6 inches across with the Garand. Typical troops cannot do as well.

The artists have also shown carelessness in researching the topic. The weapon illustrated is a fair rendition of an M1A (a semi-automatic variant of the M14). It bears little resemblance to a Garand. In general the artwork in your magazine is excellent, and I hope to see more of the Hunts's work, but they should take a little

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more care to render things accurately. Enclosed is a photograph of the M1 Garand. Please forward it to the Hunts.

Further military definitions. The term "rapid fire" refers to the technique of providing aimed fire with a semi-automatic weapon as rapidly as one can. To the U.S. military, there is no such thing as a "rapid-fire" gun or "rapid-fire" version of a weapon; it's a technique, not a type of weapon. A skilled rifleman can provide about one shot per second of rapid fire. As Mr. Fontenay implies, the term "semi-automatic" means that each pull of the trigger fires one shot until the weapon runs out of cartridges. A "burst" refers only to multiple shots from a fully automatic weapon, such as a machine gun. The M1 Garand cannot fire bursts. These definitions are not misused in the circles in which I move.

Consequently, I am disappointed in the editor. It is pure propaganda to mention Gatling as working on "rapid-fire" weapons and then put the Garand in the same class; Gatling is famous for developing the first machine gun. It is also pure propaganda to describe the output of an M1 Garand as a "chattering burst."

If Mr. Schmidt does not have the knowledge to pick this out, he should pass such articles on to those who do for review. *Analog* should not be serving as a mouthpiece for Handgun Control Incorporated and its ilk any more than it should be running articles for the National Rifle Association.

G.R. PATTERSON III

Somerset, NJ

Dear Terri Czeczko, Art Director:

We wanted to extend our deepest apologies for the technical error that was made in the illustration for "An M-1 at Fort Donelson."

Since research is an aspect of illustration we particularly enjoy, we regret making such a profound error.

Honestly, in our five years as professional illustrators (having done several books with historical content) we have never made an error or received letters of complaint. This is a first and hopefully the last. In the future, we will take extra measures to assure *complete* technical accuracy in our illustrative work.

We hope that you will have continued confidence in our ability as illustrators, and again we regret any problems the M-1 illustration has caused you and the editorial staff at Dell Magazines.

Thank you Terri.

JONATHAN & LISA HUNT ■

EDITOR'S NOTE: If you would like your address to appear with your Brass Tacks letter, then please type the address at the bottom *of the letter, after your signature.*

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UPCOMING EVENTS Anthony Lewis

17-19 February
BOSKONE XXXII (New England SF conference) at Sheraton Tara, Framingham, Mass. Guest of Honor—Diana Wynne Jones, Official Artist—Ruth Sanderson, Special Guest—Fred Lerner, Featured Filker—Talis Kimberley. Registration—$32 until 15 January. Info: Boskone 32, Post Office Box 809, Framingham MA 01701-0203. g.dennett@genie.geis.com

2-5 March
WORLD HORROR CONVENTION 5 at Sheraton Colony Square, Atlanta, Ga. Guest of Honor—John Farris, R.L. Stine, Neil Gaiman, Alan M. Clark, Alice Cooper. Registration—$75. Info: World Horror '95, Box 148, Clarkston GA 30021-7148 (include SASE). ekramer5@genie.geis.com

17-19 March
LUNACON 95 (New York city area SF conference) at Rye Town Hilton, Rye Brook, N.Y. Guest of Honor—Poul Anderson, Artist Guest of Honor—Stephen Hickman, Fan Guest of Honor—Mike Glyer. Registration—$30 until 17 February, $40 at the door. Info: Lunacon 95, PO Box 3566, New York NY 10008-3566. lunacon@lunacon.org

22-26 March
INTERNATIONAL CONFERENCE FOR THE FANTASTIC IN THE ARTS (academic SF conference) at Airport Hilton, Ft. Lauderdale, Fla. Guest of Honor—Joe Haldeman, Guest Author—Pat Cadigan, Guest Scholar—Peter Hunt, Permanent Special Guest—Brian Aldiss. Info: Conference Chairman Donald Morse, English Department, Oakland University, Rochester MI 48063.

24-28 August
INTERSECTION (52nd World Science Fiction Convention) at Scottish Exhibition & Conference Centre, Glasgow, Scotland. Guests of Honour—Samuel R. Delany & Gerry Anderson, Fan Guest of Honour—Vin¢ Clarke, TMs—Peter Morwood & Diane Duane. Registration—£80/US$125/CDN$160/DM210/DFI 240 from 1 October 1994, Supporting—£15/US$25/CDN$30/DM40/DFI 45 through 1995. At-door rates not set as of the time of this listing but will be greater than current attending rates. This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, Panels, films, fancy dress competition—the works. Join now and get to nominate and vote for the Hugo Awards and the John W. Campbell Award for Best New Writer. Info: Intersection, AdMail 336, Glasgow G2 1BR, UK or intersection@smof.demon.co.uk; Intersection, Box 15430, Washington DC 20003-4030, USA. (301) 345-5186 voice/fax

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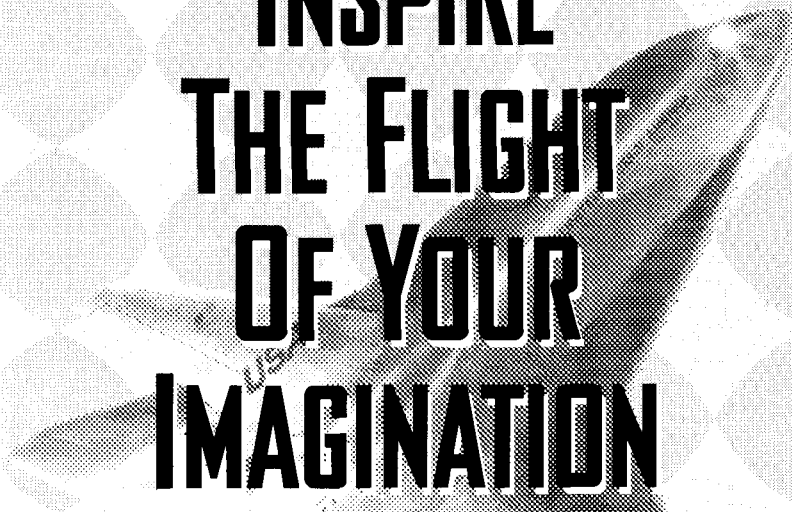

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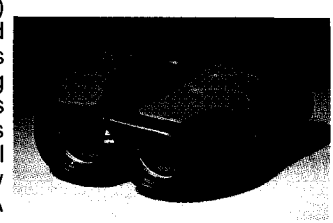

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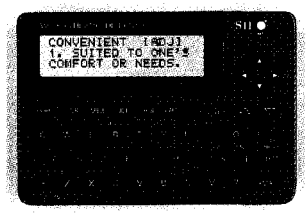

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